

**National Transportation Planning:  
Lessons from the U.S. Interstate Highways**

Draft

Marlon G. Boarnet  
Departments of Planning Policy, and Design and Economics  
University of California, Irvine  
and School of Policy, Planning, and Development  
University of Southern California (effective January 1, 2012)

September 19, 2011

## **I. Objective**

Many developing countries are building national transportation infrastructure, in anticipation of rapid increases in travel demand. What institutions and processes ought to be fostered, and how can institutional development be encouraged in parallel with and in advance of political decisions on transport projects, route locations, and financing methods? The United States faced similar questions in the early 1900s, and this paper examines the U.S. experience to draw lessons that can be applied in a developing country context. This paper first gives a brief history of the U.S. highway program, and then discusses key developments that highlight institutionally robust choices that might be applied elsewhere and also shortcomings in the U.S. experience. The paper closes with a set of lessons and policy advice, and a brief postscript on the likely role that transport infrastructure will have on economic geography.

## **II. U.S. Highway History**

The U.S. Interstate Highway system was arguably the largest public infrastructure project in history. The 1956 National Defense and Interstate Highway Act (hereafter the Interstate Highway Act) allocated \$25 billion, from 1957 through 1969, for construction of the 41,000 mile National System of Defense and Interstate Highways (Levin, 1959, Rose, 1990, Taylor, 2000, Swift, 2011). Yet the U.S. came late to national highway building. In the years prior to World War II, Italy and France had more extensive highway systems, and the great Autobahns of Germany were models for a U.S. system that was inferior by comparison (Karnes, 2009, Chapter 1 and p. 82). The construction of the U.S. Interstate Highway system followed three quarters of a century of debate and institutional development that transformed American roads from a set of disconnected projects built and operated by state and local governments into a comprehensive network that was conceived, planned, and funded by the national government.

From the late 1800s to the 1956 Interstate Highway Act, three questions dominated highway politics. First, who would lead in highway building, the federal government or the states? Second, who would pay for the new roads, or equivalently what financing instruments would be used? Third, if there were to be a national system, how would it be planned, by whom, and using what methods? Eventually these questions were answered in favor of strong federal leadership for a national system funded by user fees, largely gasoline taxes. The national system was planned in waves over several decades by the Bureau of Public Roads, which became an early leader in developing methods, data sources, and planning techniques and which used that leadership position to argue for a national system and to influence policy debate. The political questions of who would lead the highway-building effort and who would pay were heated and the outcome was never pre-ordained. From the early 1900s to the 1956 Act, the U.S. developed a set of institutions that fostered the development of a highly professionalized community which allowed rapid implementation of national highway building once the political debates were settled. Yet those same institutions that proved adept at building the national system proved less well suited to the task of managing transportation in a post-construction era.

### *A. The Early Road Building Era: Late 1800s to 1916*

At the turn of the 20<sup>th</sup> Century, road building in the U.S. was almost exclusively an activity of state and local governments. There was heated debate about whether road building should be a function of the federal government or something left to the states (Karnes, 2009, p. 7; Rose, 1990, Chapter 1). The late 1800s saw the development of what became a broad and active “Good Roads” movement which was popular among rural and agricultural interests. The movement pre-dated the automobile – the first “Good Roads” advocates were bicyclists – but quickly came to focus on road building to support car travel (Gutfreund, 2004, pp. 8-10). Rural road building was viewed as a way to empower farmers, by allowing them to move their goods more easily to market and to access multiple railheads, thereby reducing the local monopoly power of the railroads (Gutfreund, 2004, p. 10).<sup>1</sup> This emphasis on roads as a benefit to farmers was an influential perspective in a rural nation; in 1900 sixty percent of all Americans lived in rural areas.<sup>2</sup>

In 1905, the first federal road agency, the Office of Public Roads, was created within the U.S. Forest Service. Its role was to advise other agencies in matters related to road construction and to build roads on U.S. federally owned lands (U.S. FHWA, 2011a). The responsibility to build roads on federal lands provided ample opportunity for this young agency to develop expertise. Twenty percent of the land area of the United States is federally owned, primarily in national parks, national forests, and other preserves, and in the western states the percentage of federally owned land is even higher (U.S. Bureau of the Census, 2011, Table 365). The agency’s road construction efforts were primarily to provide car access into national parks and forests. The combination of an advising mission with an opportunity to build expertise in road building at the earliest stages of the automobile era provided the Office of Public Roads, and its successor the Bureau of Public Roads, with an opportunity to be a knowledge leader in the new field of road and highway engineering.

In 1916, the Federal Aid Road Act was passed. The bill provided the first-ever federal financial assistance to states for road construction. Under the 1916 Act, federal funds were distributed to states for road construction, typically following a 50:50 federal-state funding split. The federal funding was administered and overseen by the Office of Public Roads and its successor the Bureau of Public Roads. The spirit of the legislation was intended to foster federal-state cooperation in road building, and the question of who would plan and lead in network design and construction was still unsettled. Yet the Office of Public Roads had authority to specify engineering standards for roads that used federal funds, and that office and its successor agency aggressively used that authority to codify standards, methods, and practices to a national standard over the decades from 1916 to the enactment of the 1956 Interstate Highway Act (Rose, 1990; Seely, 1987).

---

<sup>1</sup> Many commentators have used the phrase that road building, during this early era, was intended to “get the farmer out of the mud,” reflecting the fact that the system was largely un-surfaced and that farmers were seen as primary beneficiaries of roads in this period. See, e.g., Levin (1959) and Swift (2011) for discussions.

<sup>2</sup> Data on percentage rural are from the U.S. Census Bureau, Urban and Rural Population, 1900 – 1990, <http://www.census.gov/population/censusdata/urpop0090.txt>, accessed July 18, 2011.

## *B. The Rise of National Highway Planning: 1918 – 1944*

In 1918, Thomas H. MacDonald was named chief of the Office of Public Roads. In 1919 the office changed its name to the Bureau of Public Roads, and MacDonald remained as head of the bureau until 1953 (U.S. FHWA, 2011a). MacDonald and the Bureau of Public Roads (BPR) set the tone for the rise of a national highway system, and during the interwar years, between World Wars I and II, MacDonald emphasized the development of a culture that prioritized knowledge development, analytic techniques, and objective analysis. At the time, U.S. politics was steeped in a progressive, “good government” tradition that emphasized the application of science to policy problems, creating an environment where MacDonald’s emphasis on objective analysis found a ready audience (Seely, 1987; Gutfreund, 2004).

MacDonald emphasized cooperation with the states. Each state had their own department of transportation, and the question of whether those state departments or the federal government would lead was unsettled. MacDonald used language that always framed BPR efforts as cooperating with the states (Seely, 1987, p. 56). During this time period, the American Association of State Highway Officials (AASHO), formed in 1914, was an influential voice, and MacDonald and the BPR worked hand in hand with AASHO. Often AASHO would draft national legislation, at MacDonald’s urging, for congressional committees (Seely, 1987; Rose, 1990). Yet MacDonald and the BPR also were taking steps to establish national government leadership in highway planning, even while always couching that federal leadership in the language of cooperation.

The 1921 Federal Aid Highway Act called for each state to designate seven percent of their roads to be part of the federal aid highway system – the first formalization of anything resembling a hierarchy of roads, with a national network receiving federal funding. The BPR reviewed the state’s suggestions and reserved the right of formal approval, setting a precedent for federal selection of roads and (eventually) routes that would be in the national highway system (Seely, p. 74). Yet the BPR review of state suggestions was couched in the language of cooperation, aided by the BPR’s status as an advising agency and the bureau’s growing reputation for expertise in the still new methods of highway analysis and engineering (Seely, p. 56 and p. 74). MacDonald and the BPR used their position as leading experts to maintain final say over the network, even while constantly encouraging cooperation in the form of funding (the BPR’s other purpose, beginning with the 1916 Act, was to distribute federal aid to the states) and knowledge transfer. In effect, the BPR was establishing the reputation and authority needed for national leadership well in advance of the formal question of federal and state roles being fully settled.

The interwar years also saw a shift from property tax to sales tax finance. In 1921, approximately 70 percent of highway funds were generated by property taxes, and most early road building was financed by bonds repaid by states or localities with property tax revenues. In the 1920s, many states hit their limits for bonded indebtedness, creating pressure to find new financing methods. During the Great Depression years, states consistently shifted their funding to sales taxes, as car travel was one of the few sectors that continued to grow during the 1930s. By 1948 fuel taxes raised more highway revenue than property taxes (Taylor, 2000, Figure 4, p. 203; Brown et. al, 2009). Yet throughout this time period, state and federal gas tax revenues were typically allocated to the general fund, creating constant arguments about the

appropriateness of fuel taxes that were diverted to non-highway uses. Highway interests consistently argued that fuel taxes should be user fees allocated only to highway construction, and the topic of diversion was a constant and unsettled fixture of political debate.

During the 1920s, the BPR worked aggressively to develop and disseminate methods of data collection, data analysis, and highway design. The Bureau used their position to build a community of professionals in the state departments of transportation, universities, and the private sector. At the same time, the Bureau was a constant advocate for modern highway methods, arguing in favor of national road systems, built to national standards, with user fee finance. During this time, the BPR wrote several reports which were landmarks in the debate about highway policy.

In 1939, the BPR developed a plan for a national highway network. Following precedents that dated to 1921, the Bureau solicited input from the states while at the same time developing analytic criteria that would be used to determine if state suggestions would be included in the national plan. The result was a process that reinforced the BPR's reputation as an objective and apolitical agency that followed the data and analysis wherever they led. The 1939 report also continued and strengthened the role of the federal government as the arbiter of which routes would be in the national system – states could suggest routes, but the BPR made the final route selections (Seely, 1987, Chapter 4).

The BPR updated the 1939 plan in 1944, and the 1944 national highway system was included as part of the 1944 Federal Aid Highway Act. Yet the 1944 Act allocated no funds to build the system (Rose, p. 26). Over the previous two decades, the BPR had taken on the role of building national highway plans based on a tradition of BPR leadership and analytic techniques that shielded the process from direct political influence. The question of funding the system was never settled, but the long tradition of planning established the idea that states would make suggestions but the BPR selected the routes, that the national network would be fixed in length with routes specified in legislation, and that route selection would be lodged in a professionalized agency, the BPR, and shielded from direct legislative politics.

Some commentators call the interwar years a “golden era” for U.S. highway planning (e.g. Seely, 1987). While MacDonald aspired to actually build a system, not simply plan one, funding was never sufficient for anything close to the scale needed during the Great Depression. World War II diverted national attention to military matters. The question of building, and the settling of the political questions of leadership (federal or state) and funding would have to wait until after the war.

### *C. Going Backwards: 1944 – 1955*

Postwar prosperity led to a substantial increase in driving and highway-related commerce (Rose, 1990, chapter 3). That increase exacerbated the gap between U.S. highway needs and available funds. Federal highway spending had been largely suspended during World War II, leading to a backlog of maintenance and construction needs (Rose, chapter 3). Yet funding for highways decreased as a percent of gross national product (GNP) after the war. Karnes (2009, p. 88) states that before World War II, the U.S. spent 1.4 percent of on roads, while in the years immediately

after World War II the nation spent 0.2 percent of GNP on roads. The nation, it seemed was going backwards.

The 1920s and 1930s political consensus in favor of highway building was also fraying. Everyone agreed that highways were vitally needed, but groups were increasingly viewing policy choices through their own particular lens. Trucking organizations argued that state gasoline taxes should be dedicated to highways, with no diversion, and that the federal tax on gasoline should be eliminated and federal aid for a national highway system should be provided from general revenues (Rose, 1990, chapter 3, p. 30). States were increasingly taking the lead in highway building, and the more populous states began to argue that they should plan and build their own networks in advance of or even in lieu of a national system. Lacking sufficient tax revenues, states were increasingly building toll roads, to the dismay of trucking interests (Rose, 1990, p. 41). The toll roads drew continued opposition from MacDonald, who had always favored free highways, but even MacDonald had begun to soften his opposition to tolls in the face of the evident gap between highway needs and available revenues (Seely, pp. 205-207).

The political debate during these years was particularly unsettled. The old questions of federal or state leadership and financing methods had been moving toward a resolution of federal leadership with gasoline tax finance in the 1930s, but that consensus was coming undone. The national highway system planned by the BPR looked more and more like a pipedream – by the early 1950s engineers estimated that California’s portion of the network would require 30 years for completion. Materials costs were rising due to the postwar housing construction boom, and in 1950 President Truman reduced highway spending as part of an effort to avoid shortages of materials needed for the Korean War (Rose, 1990, Chapter 3.) State officials increasingly looked poised to embark on their own plans. Prospects for a national system appeared bleak until matters were resolved, surprisingly quickly, in 1955 and 1956.

#### *D. The Interstate Highway Era, 1956 – 1970s*

In January of 1955, President Eisenhower used his State of the Union address to argue in favor of a national system of roads (Karnes, 2009, p. 87). Congress continued to debate questions of financing instruments, with Republicans largely favoring bonded indebtedness, while other voices argued for a “pay-as-you-go” approach. Congressional debate also focused on whether an expanded federal effort would interfere with the states’ prerogatives and plans (Karnes, p. 90 and Rose, Chapter 6). Further complicating efforts to pass a bill, proposals to use gasoline taxes to create the Highway Trust Fund – which would dedicate gas tax revenues only to highway construction – were failing to gather support from urban legislators. The decades of focus on highways as a rural project had helped create the impression that a national highway program would siphon gasoline taxes from urban areas, and that concern was reinforced by the fact that parts of the urban portion of the interstate system, as of 1954, were not specifically sited, partly in deference to local officials. To make the system more real to urban legislators, the BPR embarked on a hurried effort to designate the location of the urban interstates, in time for Congressional debate in 1956 (Taylor, 2000).

The political debates were settled in 1956. The 1956 Interstate Highway Act provided plenty of new roads, with gasoline tax finance on a sufficiently broad based not to be onerous to any one

interest group. The federal government would pay 90 percent of Interstate Highway costs – an unprecedented share and large enough to ensure that states, rather than being concerned about federal control, would enthusiastically support the bill. Urban portions of the Interstate network had been explicitly sited, which was necessary to obtain the votes of urban members of congress but also codifying a hurried planning process that had been centralized in Washington with little input from city transportation officials (Taylor, 2000).

The 1956 Interstate Highway Act designated the Interstate Highway system, largely following the 1944 BPR plan as had been revised in 1954 and 1955. The system was financed by increasing the federal gasoline tax from two to three cents per gallon (Levin, 1959). That 50 percent increase in the fuel tax rate, when coupled with increased driving, increases in other fees (e.g. taxes on tires), previous tax increases and changes in state gasoline taxes, had a dramatic effect. Revenues for highways (state and federal) increased by 381 percent from 1947 to 1959 (Taylor, 2000.) The 1956 Act required that the federal funds be expended only on the national highway system, through the creation of the Highway Trust Fund which isolated fuel tax revenues from the general fund (Levin, 1959), settling the question of diversion of gasoline tax funds. The initial effect was a revenue windfall, as had been intended to finance the new system.

The 1956 Act specified clear federal standards and federal oversight, codifying the tradition of federal leadership built for decades by the BPR. The 1956 Interstate Highway Act specified the routes, even within cities, capped the extent of the system at 41,000 miles, and established federal standards for geometric designs and the maximum weight of vehicles using the Interstate system (Levin, 1959, p. 383). The 1956 Act required that states control and limit access to the Interstate Highways, and the 1956 Act included provisions for federal acquisition of needed right-of-way if state efforts to obtain land were unsuccessful (Levin, 1959, p. 383). The Interstate Highway Act allocated \$25 billion of funding – a staggering sum – to be distributed according to the 9 to 1 federal-state matching rates. The Interstate Highway Act called for construction to occur between 1957 and 1969, providing the promise of rapid completion of the national network.

The goal of building a national system, with plans dating to 1921, would be realized. The nation mobilized in a massive effort to build the great highways. California, for example, opened more freeway miles from 1957 through 1959 than it had built in all previous years, and centerline highway miles in the state doubled again from 1960 through 1964 (Taylor, 2000, p. 210). All the states enthusiastically participated. The question of federal or state leadership had been settled in favor of the federal government. Interstate Highway construction, and with it much of ground transportation planning, became a highly centralized endeavor, funded and specified from Washington and implemented by state departments of transportation (Taylor, 2000, pp. 207-208).

In many ways, the 1956 Interstate Highway Act was a triumph of professional policy analysis over politics. MacDonald was gone, but the culture he had worked to build, of a federal agency steeped in cutting edge methods of data collection, analysis, and engineering, with broad ties to other agencies, the states, and political actors, was the basis for the 1956 Act. MacDonald's principles of federal control of route selection, national standards, a national network, and gasoline tax financing were the centerpieces of the law. Possibly more importantly, the decades-

long effort by the BPR to develop and disseminate knowledge-based approaches to highway planning and construction had built a professional community that was ready to quickly build the national network, per accepted methods of analysis and federal standard-setting, once political questions had been settled. The network was built quickly, but by the 1970s questions of what would follow after the construction was complete began to loom large, and in many ways caught the nation unprepared.

#### *E. The Post-Interstate Era, 1970s to the Present*

The Interstate Highway construction years represented a period when analysis and implementation trumped politics. The old political questions had been settled in the 1956 Act, largely in ways agreeable to all the major interests, and the national effort to build the Interstate System proceeded apace. Yet once the network was built, the highly centralized, federally controlled process, which served motorists and traffic to the exclusion of other goals, increasingly became the subject of criticism. In the past four decades, politics has re-emerged. The absence of political debates during the early years of Interstate Highway construction should be viewed as an exception, not the rule. More generally, the past four decades have witnessed a slow devolution of authority from the federal government back to states and localities, and an increasing focus on broader issues of urban transportation, neighborhood impacts, financing, and externality management.

The role of the Interstate Highways on urban areas had been mostly overlooked in the national planning for the 1956 Act. Similarly, questions of air quality did not loom large. Further institution building, both at the metropolitan level and for environmental management, proved necessary.

Federal law required metropolitan area transportation plans beginning in 1962 (Dilger, p. 74), and the 1977 Clean Air Act Amendments first required that metropolitan transportation plans be consistent with the state air quality improvement efforts that are required by federal law (U.S. FHWA, no date a). Yet in the 1960s and 1970s those requirements did not translate into anything other than a very weak role for metropolitan area planning, as the locus of transportation planning and funding was still at the state and federal level. The role of MPOs was strengthened by the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) – a landmark bill which in many ways is the break between the centralized highway construction period and the era of maintenance and decentralized planning and programming which followed. Under the 1991 ISTEA, six percent of federal aid highway funds (the revenues from the federal gas tax) were allocated directly to MPOs for projects of MPOs choosing that did not require state approval (Dilger, p. 74) – the first time federal gas tax funding went to any sub-national entity other than state transportation departments and the first time MPOs could use federal funds for projects without state approval.

At essentially the same time, the 1990 Clean Air Act Amendments (CAA) strengthened the role of MPOs in assessing the consistency of transportation investment plans (TIPs) with Clean Air Act requirements – a process known as conformity. Conformity requires that the investments of



federal transportation funds be consistent with attaining clean air act targets.<sup>3</sup> While this strengthened the role of MPOs, the result is not a formal metropolitan governance structure for transportation. MPOs lack taxing authority, and in most instances still have no authority to program or implement their own projects. MPOs do not have land use authority. MPOs are essentially aggregators of projects specified both by states and by county and municipal governments. MPOs can have important coordinating and, in some cases, agenda setting functions, but in the U.S. metropolitan transportation decision-making is still made, depending on the state, either primarily at the state level or, in the more urbanized states, at the municipal level often with state input, direction, or constraints.

Beyond the role of MPOs, an increased federal role for mass transit has strengthened the metropolitan and urban focus of transportation policy. In 1982, the Surface Transportation Assistance Act provided that about one-ninth of federal gas tax funds would be allocated to mass transit – the first such allocation of gas tax funds, as a percent of gas tax revenues, to non-highway uses (U.S. FHWA, no date b). In the 1991 ISTEA Act, the federal reimbursement rate was set at 80 percent of construction cost for non-highway projects – close to the 90 percent share for most highway projects (Dilger, p. 77). Of the \$151 billion in federal funds authorized in the 1991 ISTEA legislation, \$32 billion was allocated for mass transit – more than double the funding level from the previous federal aid highway act (Dilger, 1977). Also, states were allowed under the 1991 ISTEA Act to shift up to half of their federal highway funds to other programs or mass transit, and the legislation included some funds that were not restricted by mode or program and could be spent by states at their discretion on projects such as, for example, bicycle paths, traffic management, or landscaping and beautification (Dilger, p. 77). All of this represented a broadening of the “highway only” focus of the federal role to support a more multi-modal system.

While the local and metropolitan role was slowly becoming stronger, the gasoline tax finance system of the 1956 Interstate Highway Act was coming under increasing pressure. Gasoline tax revenues, at both the state and federal level, did not keep pace with driving or highway construction costs. Increased vehicle fuel economy, mandated by the federal government in the 1970s, spurred the gap between gas tax revenues and miles driven, and the cost of building highways in urban areas increased faster than gas tax revenues in part due to increases in urban right-of-way and construction costs. Political pressure made it increasingly difficult to raise the gasoline tax, which is assessed on a per-gallon basis rather than as a percent of total fuel costs (and hence has no indexing for inflation.) The federal gas tax was last increased in 1993 (Brown, 2009).

In 2008, the Highway Trust Fund, for the first time since 1956, had insufficient funds to meet obligations, and Congress authorized additional funds from general revenues (Weiss, 2008). As federal gas tax funds dwindled, localities began to fill the gap. As of 2005, 20 of the 58 California counties – and all of the larger counties in the state’s four largest metropolitan areas – had passed local sales taxes to raise funds for transportation (Crabbe, Hiatt, Poliwka, and Wachs

---

<sup>3</sup> Formally, states with non-attainment areas must develop a state implementation plan that demonstrates how their air basins will be brought into compliance by a future date specified in federal law. Conformity requires that MPOs demonstrate how their TIP, and associated policies in a regional transportation plan, are consistent with the actions and outcomes in the state implementation plan.

2005). In the greater Los Angeles area, the Southern California Association of Governments (2008) estimates that 70 percent of the funds for their most recent (2008) five-year regional transportation plan will be from local sources, of which the largest share is county sales tax increments devoted to transportation.

The increased role for local transportation finance is a beneficial development in a transportation system that had too much ignored the needs of metropolitan areas, but the primary local tax in California – the sales tax – is a not an efficient transportation tax instrument. Sales taxes serve neither to manage travel demand (as would occur with, for example, mileage or congestion fees) nor do sales taxes capture land value increases created by transportation infrastructure (as a property tax would). Also, the patchwork system of county-level finance in California creates a risk that projects that either span counties or that benefit more than one county will be overlooked. AS control of highway finance has devolved from the federal government back to states and localities, old questions of coordination and the choice of tax instruments have re-emerged. Boarnet and Haughwout (2000) have argued that for many urban transportation projects and policies, the greater metropolitan area is the natural geographic locus of benefit and impact, and the metropolitan role in transportation governance still needs to be strengthened in the U.S.

### **III. Key Developments**

The U.S. developed a set of institutions and practices that were well suited to the careful planning of a national highway network, and the rapid construction of that system once political debates were settled. Yet the institutions and practices that were well suited to an era of construction have proved less suited to a post-construction era. First, consider what worked well in the U.S. experience.

#### *A. What Worked Well: Key Factors Supporting the Construction of the Interstate Highway System*

##### 1. Development of a Hierarchy of Roads

The question of whether the federal or state governments would take the lead in building the nation's highway system was settled through a decades-long process of developing a hierarchy of roads. Beginning in 1921, the Bureau of Public Roads (BPR) began the process of planning a national highway system, and that planning extended to the 1939, 1944, and 1955-1956 plans. From the earliest stages, the BPR had authority to review and determine which routes were included in the national highway system. Under MacDonald's leadership, the BPR always emphasized that their work was in cooperation with the states. At the same time, from the 1910s to the 1950s the BPR cultivated an image as an analysis-driven, apolitical agency, and the BPR had a clear position as a locus of expertise of the highest order. Both points were important in establishing the BPR's ability to plan a national highway system.

In successive waves, spanning decades, states were asked to submit roads to be included in the national network, and in each planning phase the BPR exerted increasing authority to review state suggestions and make final decisions on the national network, based on analyses that were

cutting edge at the time. In this way, the long debate over whether the federal or state governments would lead was settled in favor of a national highway system, planned by an expert federal agency shielded from direct political influence, with the length of the system fixed, and with the states having responsibility for the feeder networks into what became the national, trunk-line system. The 1956 Interstate Highway Act, the culmination of this process, specified the length of the system (41,000 miles) in statute, and the routes were designated by plans with only fine-grained alignments to be determined after 1956.

## 2. Development of Professional Capabilities

The BPR was established as an advisory agency, but also had authority to build roads on federally owned lands. Starting with the 1916 Federal Aid Road Act, the BPR had authority to enforce federal standards on state highways built in part with federal funds. That combination allowed the agency to develop expertise and to consistently use their advising and standard-setting role to bolster their position as the leader in the analytics of highway planning. The BPR pioneered methods of geometric design, data collection, and traffic and economic analyses. In many ways, the fields of transportation engineering and planning evolved with the BPR and often under direct support and guidance from the BPR.

During MacDonald's tenure, the BPR constantly reinforced its image as an apolitical, expert, analysis-driven agency. The BPR was shielded from direct legislative oversight, having authority to review state suggestions for routes (dating to 1921) and to specify standards for highways built using federal aid (dating to 1916). That oversight authority was reinforced over time and reflected in the legislative language of the 1956 Interstate Highway Act. Yet the BPR wielded political influence. From the 1920s to the 1950s, the BPR staffed congressional committees, built long-term relationships with legislators, and with trade organizations such as AASHTO drafted legislation. The BPR was a strong proponent of gasoline tax finance, and a strong opponent of toll finance, and the BPR consistently produced analyses to support their policy positions. While the BPR was anything but a neutral observer, its advocacy was based on analysis – often using techniques developed by the agency itself – and so the BPR consistently occupied a position as a voice for fact-based policy analysis in an era when politics in the U.S. had a strong “good government” emphasis on applying knowledge and science to policy problems.

The development of professional expertise extended well beyond the BPR, and the BPR fostered a culture of professionalism across a broad spectrum of agencies and non-governmental organizations. State highway departments formed the American Association of State Highway Officials (AASHO) – the predecessor to the current American Association of State Highway and Transportation Officials (AASHTO) – in 1914 (Rose, p. 8). MacDonald's philosophy that the federal government was working in cooperation with the states allowed a long period of partnership with AASHO, including the development of professional expertise in all 50 state highway departments.

The National Advisory Board of Highway Research was formed in 1920, and renamed the Highway Research Board in 1925 and the Transportation Research Board in 1974. The National Advisory Board of Highway Research and its successor entities were (and remain) part of the

National Research Council, a high-level advisor to the nation on science, engineering, and medicine, affiliated with the National Academy of Sciences. This placed highway research at the most elite levels of inquiry, signaling that the development of transportation planning knowledge was a national priority. Today, the Transportation Research Board has an annual budget of \$90 million, of which 39% is provided by state Departments of Transportation through longstanding cooperation with AASHTO (TRB Mission and Services web page, 2011, [www.trb.org/AboutTRB/MissionandService.aspx](http://www.trb.org/AboutTRB/MissionandService.aspx)).

The BPR consistently funded studies over the decades and worked tirelessly to create and promulgate methods for data collection and analysis. In 1922, the BPR cooperated in the first regional traffic counting projects, in Chicago and Cleveland (Seely, 1987, p. 167). At BPR urging, by 1930 eleven states had traffic counting efforts underway (Seely, 1987, p. 167). The BPR developed a network of professionals in state and city transportation agencies, universities, and among trade organizations, and the BPR took an active role in promoting data collection efforts and analysis techniques that would bolster their view that highway planning should be a scientific process based on objective methods and designed to accommodate traffic flow and not to serve other goals. The landmark work that led to the development of travel demand models was conducted by professors at Columbia University, with funding from the BPR (Mitchell and Rapkin, 1954). When the time came to build the Interstate Highway System, the U.S. had been developing expertise, data resources, and methods for four decades in a professional network dispersed across state and federal agencies, university research centers, and the engineering community. The BPR saw their mission as, in part, knowledge and skill creation and dissemination.

One concomitant of the development of dispersed professional skills is that those skills were developed at multiple levels of government, in the public and private sectors, and in agencies with multiple missions. After 1956, the U.S. Census took the lead in providing data for highway planning analyses, developing the Census Transportation Planning Package which was used by many city and metropolitan authorities for travel demand modeling. The Census Bureau was the lead agency for national surveys of transportation and travel behavior that began in 1969 and continued in 1977, 1983, 1990, 1995, 2001, and 2009. Hence questions of data collection were lodged, appropriately, in the country's premier data collection agency.

Many metropolitan areas collected their own data, more tailored to local needs. In the 1950s and 1960s, the Chicago Areas Transportation Study was a landmark in collecting travel data and developing travel demand models. (Recall that with BPR cooperation Chicago developed one of the first traffic counting projects in 1922.) Most other large metropolitan areas have similarly collected travel data and built travel models for decades. Smaller cities and state governments typically focused more on engineering methods, roadway design, and safety analyses, and again that tradition, often funded by state departments of transportation, stretches back to the early automobile years of the 1920s and 1930s.

The development of a broad culture of professional skills allowed continued creation of additional national agencies as new needs were identified. In 1970, the National Highway Traffic Safety Administration was created within the U.S. Department of Transportation with a mission to both implement vehicle and highway safety legislation and to be a leader in

improving vehicle and highway safety. In 1991, the Bureau of Transportation Statistics was created in the U.S. Department of Transportation, providing a strong liaison to data collection housed in the Census Bureau and enhancing the Department of Transportation's in-house capabilities in data collection, survey design, and data analysis. Similar developments have occurred in the states. In 2008, California passed landmark legislation requiring that metropolitan transportation and land use plans achieve greenhouse gas emission reduction targets. The legislation – Senate Bill 375 – is administered by the California Air Resources Board (ARB), which previously had focused on emissions measurement and vehicle technology. The ARB has begun an aggressive process of outreach and collaboration to metropolitan planning organizations, the California Department of Transportation, and universities and consulting firms. All of this is made possible by and continues the legacy of the dispersed network of professionalism seeded in the 1920s and 1930s. Much of that dates to the BPR's role as an advisory agency and the BPR's decades-long effort to establish a leadership position in both the development and the broad dissemination of skills and techniques.

### 3. Excellent Alignment of Incentives to Build a National Highway Network

While federal leadership in highway planning was entrenched through the BPR's plans for national highway systems dating to 1921, Congress had never authorized funding for the ambitious national plans first developed by the Bureau in 1939. In the post-World War II years, with traffic outstripping allocated federal revenues, it was unclear whether the federal government would take the lead in building the national system. Some of the larger states had moved ahead, building the first modern freeways (California), toll roads (Pennsylvania) and parkways (New York), and it was possible that a national network built to centralized federal standards and routes would not have been realized, with states taking leadership instead. The 1956 Interstate Highway Act, by settling the key questions of federal-state roles and financing instruments, established an excellent set of incentives for rapid building of the national highway network in the form that had been planned by the BPR over the decades.

Four characteristics of the 1956 Act established an incentive structure that worked well for purposes of building a national highway system. (1) The routes for the national highway system were selected by the federal government, continuing the practice that the BPR had set decades earlier when it established its prerogative to select which highways would receive federal aid. (2) The 1956 Act specified geometric designs, engineering standards, and access restrictions, often in the legislation, drawing on the tradition that the BPR had established of federal leadership in highway engineering. (3) The national system was capped at 41,000 miles in the 1956 Act, reducing states' incentives to lobby to include additional roads in the national highway system, as such lobbying would require revisiting the legislation to have any hope of success. (4) The large federal funding share, 90% of construction costs, created enthusiastic participation among state departments of transportation. Highway building enjoyed broad popular consensus in the 1950s, but the large federal funding share ensured that the states enthusiastically built the system to national standards.

The net effect was that the national highway system, in its physical extent, routes, and design standards, was a centralized project built to federal specifications, and the massive infusion of new federal funds created a willingness on the part of state departments of transportation to

cooperate in the national project. During the years of Interstate Highway construction, from 1956 to the early 1970s, each state department of transportation largely viewed their mission as building the national network to national standards. All four of the characteristics of the 1956 Act were necessary for this alignment of incentives. A large federal funding share without a network that was capped at 41,000 miles following specified routes would have created powerful incentives for states to lobby to include other, more locally-serving roads. Specifying the system in detail while offering a smaller federal funding share might have created recalcitrance on the part of some states, particularly those with already well developed highway programs of their own. The combination of a large federal funding share and clear federal control over a system whose physical extent was specified in legislation was an excellent way to ensure that states became agents of the national project.

The ensuing consensus did not begin to fray until the initial construction period was largely complete, circa the late 1960s and into the 1970s. At that time, citizen groups began to oppose particular segments of the national highway plan. Often the opposition was based on local impacts, including disruptions to neighborhoods that would be severed by the urban segments of the national system. The incentive structure that was well suited to building a national network that connected metropolitan areas was less well suited to managing within-metropolitan transportation needs. The local context that was vital for within-urban-area transportation was not reflected in the highly centralized national plan and its implementation under the 1956 Act, and as the U.S. continued to urbanize this became an increasingly important issue, discussed at greater length in the next sub-section on “what did not work well.”

#### 4. Choice of Financing Methods

The choice of a user fee – the fuel tax – settled the question of who should benefit from highway construction and hence policy goals. Repeatedly from the 1930s to the 1956 Interstate Highway Act, political actors argued that if fuel taxes were the primary financing instrument, then highways should be designed to benefit motorists, who were paying for the roads (see, e.g., Rose, 1989, Seely, 1987, and Karnes, 2009, chapter 6). Competing goals, such as using highways for urban revitalization, to bolster city economies, or as tools to help spur redevelopment or improve land use, were overshadowed by the argument that if motorists were paying, then the roads should be built to move traffic and not to serve other larger and yet (in the minds of the engineers who dominated these debates) more nebulous goals (see, e.g., Rose, chapters 1 and 2, Taylor, 2000).

The choice of gasoline tax finance, with gas tax revenues dedicated to highway construction in the form of the highway trust fund, reflected the long-held position of MacDonald and the Bureau of Public Roads. MacDonald viewed tolls as impracticable, and in 1938 the BPR authored the influential report “Toll Roads and Free Roads” which used traffic counting methods pioneered by the Bureau to estimate demand for roads. The report argued that only a small fraction of a national toll road network would generate enough traffic to pay for itself, and as an alternative argued in favor of a national highway network financed through gasoline tax fees (Seely, 1987, Chapter 8, esp. pp. 169-171). At this time, the BPR was developing methods to estimate revenue from gasoline taxes, often by combining traffic data collected by the agency with estimates of gas tax revenues per vehicle mile (Seely, 1987, p. 167). In typical BPR

fashion, the 1938 report was steeped in data and analysis and presented a political choice – how would highways be financed, who would pay, and hence who would benefit – as an exercise in objective analysis (Seely, Figure 14 of Chapter 4 and Chapter 8).

Gasoline tax finance proved well suited to the task of road construction, tapping a broad and rapidly growing tax base during a period of rapidly increasing use of the automobile. The large increases in revenues created by the 1956 Act and the gas tax increases that followed funded a massive construction program, the scale of which had not been seen. But gasoline tax finance also inadvertently sowed the seeds of the current fiscal crisis in America's transportation system, and also cemented a "traffic only" view of highways that proved ill suited to the realities of metropolitan areas or the post-construction period that would follow.

## *B. What Did Not Work Well: A Nation Unprepared for the Era Following the Construction of the Interstate Highways*

### 1. Focus Only on Highways

From 1916 to the 1960s, national transportation planning focused on highways. The first, tentative, federal role in mass transit began with the Urban Mass Transportation Act of 1964, which created the Urban Mass Transit Administration (the predecessor to the current Federal Transit Administration) and which allowed the appropriation of federal funds, from general revenues, to support transit capital costs (U.S. FHWA, 2011b). It was not until 1973 that federal gas tax revenues from the highway trust fund could be used for mass transit expenditures.

One of the great debates of the crucial 1920s to 1950s time period was whether gas taxes could be diverted to uses other than highways, and automobile interests and highway promoters consistently complained about the practice of depositing gas tax revenues in general fund accounts where they might be diverted for non-road uses. The highway trust fund, as of 1956, required that federal gas tax revenues only be used for building the national highway system. Yet the national focus on highways went beyond the question of the use of fuel taxes – in general, for a half century, federal efforts were focused only on one mode, the automobile. Eventually, as is discussed below, the federal focus crowded out what had been a vibrant multi-modal transportation planning process in the nation's larger cities and metropolitan areas.

### 2. Failure to Conceive of Two Systems – Inter-Metropolitan and Intra-Metropolitan

For decades before the 1956 Interstate Highway Act, roadways in the U.S. were considered to be of two types – rural roads that connected farmers to markets, and urban streets to facilitate within-city travel. The two systems were quite distinct. Urban travel was the domain of city officials, and traffic congestion was typically the primary urban transportation issue.<sup>4</sup> Urban highway plans were pursued aggressively in many cities before World War II – examples include Detroit, Boston, San Francisco, Chicago, and Los Angeles. In describing those efforts, Taylor (2000) notes that urban road planning was typically focused on multiple modes, tied to the land use character and the context of the city, and often planned to disperse traffic through networks

---

<sup>4</sup> In California, until 1931, state highways ended at the borders of incorporated cities, signifying the demarcation between the inter- and intra-metropolitan systems (Taylor, 2000, p. 204 and note 9).

that would be more dense than the Interstate System that was eventually built but with slower design speeds. The urban highway plans of the pre-1956 era were typically designed with attention to the context of the surrounding urban fabric. National planning – connecting cities across vast expanses of empty land – typically focused on providing infrastructure, and questions of congestion management or integration into nearby land uses were often viewed as being meaningless.

Two developments led to a national highway system that, while having a large impact on cities, reflected little consideration of the complexities of intra-metropolitan travel. First, to pass the 1956 Interstate Highway Act, federal officials hurriedly determined the location of interstates within cities and metropolitan areas to make the system tangible to urban legislators, and hence to obtain their votes (Taylor, 2000). Second, the highly centralized nature of the 1956 Act, with routes and standards specified at the federal level and with a generous 90 percent federal funding share, pushed aside the voices who were calling for more context-sensitive, multi-modal urban transportation plans. The amount of federal funding was too large for states to do anything but enthusiastically build the national highway network. In addition, the legacy of gasoline tax finance and the view that the roads would serve traffic and not other goals, promulgated by decades of BPR engineering studies and advocacy, created a context where other impacts such as effects on mass transit systems, central city economies, and urban neighborhoods were not considered. The national project, from 1956 to the mid-1970s, was to build the Interstate Highway system, and that project reflected the methods and sensibilities of an inter-metropolitan focus with little appreciation for the ways in which transportation planning in congested urban areas differed. Urban transport plans of the 1930s and 1940s that focused on alleviating and dispersing congestion, integrating automobiles with other modes, and building roadways with slower design speeds, less capacity, and hence requiring less land and being less disruptive to neighborhoods were pushed aside in the enthusiasm of the Interstate Highway era. If anything, the provision of a 90 percent federal match for a system that was capped in centerline miles but that did not specify the number of lanes may have encouraged cities to build large, multi-lane freeways that required large amounts of land, focused traffic in ways that created bottlenecks, and were particularly disruptive to urban neighborhoods (Taylor, 2000).

### 3. Environmental and Metropolitan Institutions Were Not Considered in the 1956 Interstate Highway Act

The 1956 Interstate Highway Act was a triumph of an inter-metropolitan vision over a metropolitan one. Ideally, the trunk line system would have been conceived as two systems – one inter-metropolitan and one intra-metropolitan, with links articulated between the two. State highway departments, the recipients of the massive increase in federal funds, were empowered, and urban and metropolitan voices were muted and left aside.

There were contrary voices that anticipated impacts in cities even in the early days of Interstate Highway construction, but they were few and far between. A young scholar from the Northeast, Daniel Patrick Moynihan, was one of the critics of the urban impact of the nation's highway program. In 1960 (p. 19), Moynihan wrote critically of the new interstate program, lamenting the lack of attention to its affects on metropolitan areas. He said, "Highways determine land use, which is another way of saying they settle the future of the areas in which they are built." He



predicted that, without metropolitan planning agencies (virtually nonexistent in the U.S. at the time), the new highways would sever urban neighborhoods, leading to patterns of neighborhood decline and outlying growth that were unanticipated by most and hence would catch cities unprepared. Years later, in 1991, while serving as Senator from New York, Moynihan authored the ISTEA act which brought a substantial change in U.S. transportation policy, shifting focus from road building to include maintenance, providing a role for metropolitan planning organizations in forecasting compliance with the federal clean air act, and providing some federal funds dedicated to congestion management and improved air quality. ISTEA, in effect, introduced elements of metropolitan planning into what had long been essentially a rural and inter-metropolitan program. Yet that effort to build effective metropolitan transportation institutions still lags, and a legacy of the great highway construction era is a still impoverished landscape for metropolitan transportation planning, finance, and implementation.

Relatedly, articulating the link between transportation planning and environmental concerns, which is more commonly an urban issue, was overlooked in the 1956 Interstate Highway Act. Partly that was due to a lack of appreciation for the role that environmental externalities would play at that time, but the failure to build strong metropolitan planning institutions left the nation ill prepared to handle environmental issues in ways other than vehicle technology. Environmental institutions and practices have been appended onto the federal aid highway structure, most notably through the conformity requirements in the 1990 Clean Air Act and the 1991 ISTEA. Beyond that, states such as California are pioneering efforts to link land use and transportation planning, but such efforts still exist outside of (or at best parallel to) the existing federal funding and planning framework.

#### 4. The Fiscal Crisis of Gasoline Tax Finance

The user fee principle – embodied in the 1956 Interstate Highway Act which allocated gasoline tax revenues to the highway trust fund – made sense for inter-metropolitan transportation. Yet severing the link between highway finance and property values in urban areas proved problematic in the long run. Urban transportation infrastructure, by improving access, creates land value premia nearby.<sup>5</sup> Improved transportation causes land values to rise, which will increase the cost of obtaining right-of-way for future infrastructure improvements or additional capacity. A property tax finance system can capture some of the increased land value, and urban transportation systems before the U.S. Interstate Highway system had long been tied to land value capture. Examples include the use of early passenger rail systems that supported real estate development in the U.S. and Japan, which are examples of land value capture in the private sector (see Bernick and Cervero, 1997, chapters 2 and 12).

The problem of gasoline tax finance was obscured for years by the initial windfall of revenues as fuel consumption, and hence the tax base, increased rapidly in the decades after World War II. Further obscuring the difficulty of gasoline tax finance was the focus on inter-metropolitan travel. Building highways across vast expanses of sparsely settled land to connect cities in a large country meant that the inter-metropolitan system faced few land price pressures. In the open spaces between cities, the new highways did not much increase land prices and the primary beneficiaries were motorists, not land owners. The user fee concept was well suited to the portion of the network that was inter-metropolitan, and it was only the intra-metropolitan system that would face pressure under gasoline tax finance. Yet in 2004, 60 percent of all vehicle miles traveled on the U.S. Interstate Highway system were on the urban portion of the network, with most of those being within-metropolitan area trips.<sup>6</sup> The shortcomings of user fee finance are intimately tied to the fact that the national highway system that was conceived as inter-metropolitan in nature, motivated by rural needs and a concept of cross-country transport, became the backbone of the nation's metropolitan transportation systems.

#### **IV. Lessons**

##### *A. Foster Broad Professionalization*

The BPR example is a salient one. That agency believed that its mission included building a broadly based culture of professionals who could help guide national highway building once political questions were decided. India would be well advised to follow a similar strategy. A national agency with responsibility for thought leadership in transportation, and with an advising and knowledge dissemination role in addition to a planning mission, would be helpful. That

---

<sup>5</sup> The theory is as old as the monocentric urban model, e.g. Fujita, 1964. For evidence of house price premia near new highways, see Boarnet and Chalermpong, 2002.

<sup>6</sup> From data cited by Representative Thomas Petri, chair of the Subcommittee on Highways, Transit, and Pipelines, who stated that in 2004 there were 267 billion vehicle miles driven on the rural portion of the interstate highway system, 26 billion vehicle miles on the small urban portion of the interstate system, and 434 billion vehicle miles on urban interstate highways, before the U.S. House of Representatives Subcommittee on Highways, Transit, and Pipelines of the Committee on Transportation and Infrastructure, June 27, 2006, Washington, D.C.: U.S. Government Printing Office, p 2.

national agency should be home to the most sophisticated expertise available. The agency should be tasked to work cooperatively with sub-national governments, universities, and the private sector to build expertise throughout the country. This would include funds to sponsor studies, internship programs, and exchanges at universities.

The techniques pursued would differ in some ways from the methods of traffic counting, economic analysis, and highway geometric design pursued by the BPR. In addition to those functions, a modern-day national highway planning agency should be a leader in applying new technologies, including geographic positioning system (GPS) tracking technology, intelligent sensing of traffic, real-time methods for traffic management, and the application of advanced sensing technology to monitor the structural integrity of bridges and roads. Methods to assess the environmental footprint of vehicles, fuels, and projects and policies should be developed, and the national agency should foster leadership in the behavioral and policy aspects of transportation as well as in the engineering aspects. Applications to travel demand estimation, traffic management, traffic safety, cost allocation, and economic analysis should be studied and refined. This would require reaching out to technical and statistical agencies, and, like the BPR, a national highway planning agency in India should be a thought leader while working cooperatively with a broad range of agencies and stakeholders. The goal should not be to isolate expertise in one agency, but to establish a leading voice for the development of highway planning skills throughout India's society.

#### *B. Shield the National Planning Function from Direct Political Influence*

Politics will always be a part of transportation planning. The stakes are too high for it to be otherwise. Yet the BPR made the final decisions on the national highway system, including route selection and the extent of the network, shielding those questions from direct legislative influence. This proved useful, as states could suggest routes to the BPR but direct lobbying to include inefficient highways in the national system was limited and generally ineffective. Congressional debate in the U.S. focused on matters of policy – tax instruments, matching grant formulae, and the relationship between the federal government and the states. The BPR went to great lengths to establish its authority on questions of engineering and science, allowing questions of system design and standard setting to reside with the Bureau and not be subject to much legislative influence.

This shielding required political influence on the part of the BPR. The BPR drafted legislation and influenced debate, but it did both from a position of thought leadership. A similar agency in India should be similarly shielded from direct political influence. The tenure of the director should not be subject to the direct results of electoral politics, and ideally the staff should have incentives to serve long terms that allow the creation of a deep base of experience. Plans can specify standards for network design and route selection, and those plans might be drawn and redrawn repeatedly over the years. The plans should be based on clear analytic criteria, refined over time, and the size of the national network should be specified based on an analysis of needs. The planning process should support a network hierarchy, with the inter-metropolitan trunk lines the responsibility of the national government while feeder systems might appropriately be the domain of sub-national governments. Broader policy decisions should be the purview of electoral politics, but a strong agency with expert staff tasked with making technical decisions

should have the authority to determine project and route selection as funds become available. This will require that the transportation planning agency have strong political links, to ensure that their authority over the national transportation plan is not subject to detailed political influence, but those political links should be based as much as possible on a foundation of analysis and expertise.

### *C. Plan for Both Inter-Metropolitan and Intra-Metropolitan Systems*

Policy-makers should view transport infrastructure not as a set of possibly competing modal systems but as two systems, intra-metropolitan and inter-metropolitan, each with different contexts. The inter-metropolitan system is characterized by low and falling transportation costs, and the cost of land acquisition in rural areas is usually low, making capacity increases a sound choice to accommodate traffic. Because a primary purpose of the inter-metropolitan system is to facilitate trade, keeping transport costs low is a reasonable goal for the inter-metropolitan system and user-fee finance is appropriate. Because spatial networks are prone to market power – imagine a small town served by only one railway – policy-makers should either foster infrastructure that is open access or, if that is not possible, regulate any cases of market power that would lead to monopoly pricing. The interaction of transport infrastructure and economic development at the inter-metropolitan level is likely secondary to other factors, such as the location of knowledge centers and resource stocks, and so coordinating land use or location policy with inter-metropolitan transport investment will often either not make much sense and or will be a vain exercise.

The intra-metropolitan system, in contrast, is characterized by congestion, high full costs of travel (time plus money cost), and little ability to expand capacity sufficiently to keep transport costs low. Hence the objective is rarely (if ever) to provide sufficient capacity to meet demand, but to balance several modes, making progress when possible, and ideally, as e.g. Downs (1962, 1992) and Vickrey (1963) have noted, to use pricing to manage demand. The interaction of urban land prices with transportation access not only allows coordination between land use and transportation policy but requires it, and that interaction suggests both the merit of a value-capture financing tool for intra-metropolitan transportation projects and attention to the effects of intra-metropolitan transport infrastructure on location choices and urban development patterns.

The institutional and public finance structures of these two systems – the inter- and intra-metropolitan – should differ. The national system (the inter-metropolitan) should be built, operated, and maintained either by or under the direction of a national authority with an ability to make final decisions on routes and project selection. Broad parts of the inter-metropolitan system will be constant-returns-to-scale, so that after construction costs are paid average-cost pricing will work well, and even the construction costs can be paid with relatively simple user fees such as fuel taxes, although ideally fuel taxes that are pegged to the use of the system (i.e. pegged to miles driven, road wear, and environmental externalities.)

The intra-metropolitan systems should be governed at a metropolitan scale. Metropolitan transport institutions should have the authority to balance modes, link to land use, price the system, and adjust plans and infrastructure to fit local tastes and contexts and stages of urban development. This will inherently be a messier, more multi-modal, process than what will occur on the inter-metropolitan system. Anything that empowers metropolitan scale governance in

user pricing (which within urban areas will include congestion pricing and marginal cost pricing of other externalities), land value-capture tax financing, and integrating land use plans and transport infrastructure should be encouraged. This implies that the governance structures at the metropolitan level should have sufficient tax, pricing, and planning authority to meet those objectives.

The inter- and intra-metropolitan systems should be coordinated, and that coordination will require constant collaboration between national and metropolitan authorities. That collaboration should not imply a dominance of one system over the other, but rather the linking together of the two transport systems. An important lesson from the U.S. experience is that the task of building a national system should not override intra-metropolitan transportation imperatives. The development of the U.S. Interstate Highway System essentially took transportation planning away from the nation's cities, and during the construction of the Interstate Highways the planning for the metropolitan portion of the network was much too distant from cities and too centralized at the national level. A truly national system would require a balance between the national routes and the need to incorporate those inter-metropolitan lines into integrated metropolitan transportation plans. Lines of authority and tax instruments should be delineated, possibly in proportion to the fraction of inter- and intra-metropolitan traffic that will flow on specific links within the urban areas. This will likely require both modeling and collaboration between national and metropolitan authorities. The U.S. experience illustrates that national transport planners can mistakenly view a national system as strictly inter-metropolitan, ignoring the role that those transportation networks will play within cities and failing to understand the substantial differences between the inter- and intra-metropolitan contexts. The U.S. is still working to build the metropolitan institutions that were absent in the great national planning and construction effort of the 1950s and 1960s, and other nations would be well advised to bolster both national and metropolitan institutions at an early stage.

#### *D. The Choice of Tax Instruments Determines Policy Goals*

In the U.S. experience, the choice of a user fee (gasoline tax) financing instrument bolstered the voices of those who argued that the new highways should only be judged by their impact on traffic. If drivers were paying the costs of highway construction, road user benefits should be the only metric for judging highway benefits. This view has a long academic tradition, also. Classic works in transportation economics argue that road user benefits should be the only tool to evaluate highways, and that including other "non-user" benefits will double count the societal benefits of the roads (Wheaton, 1977; Mohring and Harwitz, 1962). Yet the question is not only a matter of analytics, but of policy choices, and a lesson from the U.S. experience is that the choice of financing instrument is bound up with and influences policy goals.

In urban areas, planners in the U.S. argued that highways would have impacts on neighborhoods, the central city business district, and urban growth patterns. Deciding whether those impacts would be positive or negative involved (and still involves) some normative debate. Yet the choice of user fee finance diverted attention and debate from any land use impacts, as those who focused on the inter-metropolitan network argued that if motorists were paying, impacts on motorists were the only appropriate considerations for policy analysis and debate. The choice of user fee finance exacerbated the tendency to overlook the intra-metropolitan characteristics of the system. Financing instruments are not independent of policy goals, and in this case the

choice of financing instruments reduced the attention given to goals and impacts that were unique to the urban transportation system.

#### *E. Foster a Long Planning Period*

Settling political questions related to U.S. highway policy took decades. During that time, the U.S. developed a set of institutions that built capacity and planned a system in repeated iterations and waves. The long planning period benefitted the country, as when political decisions were made there was a strong network of skilled professionals, in every state department of transportation, the federal government, the private sector, and universities, who could be mobilized to build the national system.

The U.S. experience illustrates that developing the national highway plans of 1921, 1939, and 1944 helped to shape thought and political debate. More importantly, each plan was an opportunity for the BPR to deepen their collaborative relationships with state departments of transportation and for the BPR to bolster its position as the leading authority on highway matters. A key to the U.S. planning experience was that the planning period was not simply long, but that each plan helped the BPR extend its influence, leadership position, analytical techniques, and influence.

#### *F. Plan for the Post-Construction Period Now*

Institutional development should extend beyond the initial highway construction phase. Because the U.S. pursued a largely inter-metropolitan vision of highway planning, the nation was ill prepared for the challenges of urban transportation. The highways that worked well as a national system also severed urban neighborhoods, contributed to central city decay, and were unable to respond well to the needs of the major urban areas in a multi-modal context where congestion and externality management are keys. While the national institutions in the U.S. were well developed, due to the legacy of the BPR, metropolitan institutions had been overlooked and were an afterthought. Environmental institutions grew up more rapidly in the post-Interstate era, but articulating the links between environmental institutions, metropolitan planning organizations, and the existing highway institutions is a continuing process and an ongoing challenge.

In the U.S., metropolitan planning organizations and the practice of transportation planning are now working to catch up to the more explicitly intra-metropolitan context of the modern system. This includes aggressive but still evolving efforts to develop data and methods to assess land use impacts and to tie transportation finance and planning to urban growth patterns, land use, and metropolitan economic development. The U.S. would have benefited from earlier attention to the needs of metropolitan areas and to the needs of a post-construction period characterized by a balance between modes and attention to land use, quality of life, and environmental issues.

### **V. Postscript: Transportation Infrastructure and Economic Geography**

Can a national transportation network be a tool for economic growth in underdeveloped, rural regions? Economic theory is ambiguous on this question, but the theoretical insights and experience that are available suggest that the most likely answer is that transportation links will

do more to bolster the economic position of cities than of rural areas. Falling transport costs will typically reinforce existing core-periphery patterns, boosting the position of knowledge economies and manufacturers in urban areas. If anything, improved transportation can open links for urban producers to supply rural markets. High transport costs tend to isolate markets, allowing the simultaneous existence of several essentially similar markets – imagine the small market towns that dot agricultural areas such as the American Midwest, each serving a local collection of farms and each similar to the other. As Kilkenny (1998) describes, falling transport costs will place these small market towns into Hotelling competition with each other, leading to fewer, but larger, markets. More generally, low transportation costs increase the size of market areas and hence favor concentration of production and settlement in the core areas – the large cities – *ceteris paribus* (Redding, 2010).

This does not imply that transportation improvements ought not be pursued – far from it. Efficient national transportation is important for economic development. In the U.S., Nadiri and Mamuneas (1996, p110) studied the link between highway capital and total productivity for 35 industries from 1952 – 1989. They found that the contribution of highway capital accounted for 30 percent of total factor productivity (TFP) growth in the U.S. from 1952 – 1963 and 25 percent of TFP growth from 1964 – 1972 (spanning the most rapid period of interstate highway construction, from 1956 to the early 1970s.) In later years, 1973-1979 and 1980-1989, highway capital only accounted for 2 and 4 percent of TFP growth. Large improvements in national transportation networks – such as building a national highway system – can allow improved access to resources and international markets, and can be a tool for national economic growth. But transportation by itself is less likely to be a tool for development in lagging regions. If anything, transportation infrastructure can contribute to increased growth in the developed, urbanized core regions.

The most important impact of transportation on economic geography is likely within metropolitan areas. Baum-Snow (2007) has recently provided evidence that the U.S. Interstate Highway system had an independent effect on metropolitan decentralization. Using an earlier national highway system plan to instrument the as-built 1956 Interstate system (and hence help control for the endogeneity of highway location to future urban growth), Baum-Snow (2007) found that the first new highway through a central city reduced central city population growth from 1950 to 1990 by 17 percent. Nationally, his estimates indicate that had the U.S. Interstate Highway system not been built, from 1950 to 1990 the nation's 139 largest central cities (measured in constant 1950 borders to control for changes in city boundaries during that time) would have experienced population growth of 17 percent, as compared with the realized 8 percent population decline in those central cities. Other studies (e.g. Funderburg et al, 2010, Chalermpong, 2004) support the view that highways have an important role on intra-metropolitan growth patterns.

To summarize, national highway building is not likely to spur growth in economically lagging regions. If anything, improved transport links between lagging and more developed regions will allow producers in the larger cities, who benefit from agglomeration economies, to access markets in the hinterland, further concentrating growth in cities. Yet the fine-grained pattern of transportation access within cities can importantly influence the location of population and employment growth. This is another reason to conceive of two systems – one inter-metropolitan and the other intra-metropolitan. The inter-metropolitan system is a national project, and will

likely not be an effective tool to develop lagging regions. Questions of economic geography will be secondary, at best, for the inter-metropolitan system, and the national impacts will be more important. For the intra-metropolitan system, land use impacts should be more carefully considered, as transportation infrastructure is a determinant of within-metropolitan-area growth patterns. Overall, this is another reason to lodge the two systems – inter-metropolitan and intra-metropolitan – in two sets of institutions, both equally well developed and with clear lines of authority and articulated links between the two.

## **Bibliography**

- Baum-Snow, N., 2007. Did highways cause suburbanization? *Quarterly Journal of Economics* 122, 775–805.
- Boarnet, Marlon G. and Andrew F. Haughwout. 2000. *Do Highways Matter? Evidence and Policy Implications of Highways' Influence on Metropolitan Development*. Washington, D.C.: Brookings Institution Center on Urban and Metropolitan Policy, August, 2000. <http://brookings.edu/es/urban/boarnet.pdf>, accessed July 18, 2011.
- Boarnet, Marlon G. and Saksith Chalermpong. 2001. New Highways, House Prices, and Urban Development: A Case Study of Toll Roads in Orange County , California. *Housing Policy Debate* 12(3): 575-605.
- Brown, Jeffrey R., Eric A. Morris, and Brian D. Taylor. 2009. Planning for Cars in Cities: Planners, Engineers, and Freeways in the 20<sup>th</sup> Century. *Journal of the American Planning Association* 75,2: 161-177.
- Crabbe, Amber E., Rachel Hiatt, Susan D. Poliwka, and Martin Wachs. 2005. Local Transportation Sales Taxes: California's Experiment in Transportatino Finance. University of California Transportation Center working paper, <http://www.uctc.net/papers/737.pdf>, access July 18, 2005.
- Dilger, Robert Jay. 1994. ISTEAs: A New Direction for Transportation Policy. *Publius: The Journal of Federalism* 22: 67-78.
- Downs, Anthony. 1962. The Law of Peak-Hour Express-Way Congestion. *Traffic Quarterly* 16(3): 393-409.
- Downs, Anthony. 1992. *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion*. Washington, D.C. Brookings Institution Press.
- Funderburg, Richard, Hilary Nixon, Marlon G. Boarnet, and Gavin Ferguson. 2010. New Highways and Land Use Change: Results from a Quasi-Experimental Research Design. *Transportation Research Part A* 44: 76-98.
- Gutfreund, Owen D. 2004. *Twentieth-Century Sprawl: Highways and the Reshaping of the American Landscape*. New York: Oxford University Press.



- Karnes, Thomas L. 2009. *Asphalt and Politics: A History of the American Highway System*. Jefferson, North Carolina: McFarland and Company, Inc., Publishers.
- Kilkenny, Maureen. 1998. Transport Costs, the New Economic Geography, and Rural Development. *Growth and Change* 29: 259-280.
- Levin, Donald R. 1959. Federal Aspects of the Interstate Highway Program. *Nebraska Law Review* 38: 377-406.
- Mohring, Herbert and Mitchell Harwitz. 1962. *Highway Benefits: An Analytical Framework*. Evanston, Illinois: Northwestern University Press.
- Moynihan, Daniel P. 1960. "New Roads and Urban Chaos." *The Reporter*. (April 14): 13-20.
- Muller, Peter O. 2004. Transportation and Urban Form: Stages in the Spatial Evolution of the American Metropolis. In *The Geography of Urban Transportation*. Eds. Susan Hanson and Genevieve Giuliano. New York: The Guilford Press.
- Nadiri, M. Ishaq and Theofanis P. Mamuneas. 1996. *Contribution of Highway Capital to Industry and National Productivity Growth*. Report prepared for Apogee Research, Inc., for the Federal Highway Administration Office of Policy Development, Work Order Number BAT-94-008.
- Redding, Stephen J. 2010. The Empirics of the New Economic Geography. *Journal of Regional Science* 50,1: 297-311.
- Rose, Mark H. 1990. *Interstate: Express Highway Politics, 1939-1989*, revised edition, University of Tennessee Press, pp. 1-13.
- Seely, Bruce E. 1987. *Building the American Highway System: Engineers as Policy-Makers*. Philadelphia, Pennsylvania: Temple University Press.
- Southern California Association of Governments. 2008. Regional Transportation Plan. Chapter IV: Financial Plan. [http://www.scag.ca.gov/rtp2008/pdfs/finalrtp/f2008RTP\\_Chapter4.pdf](http://www.scag.ca.gov/rtp2008/pdfs/finalrtp/f2008RTP_Chapter4.pdf), accessed July 18, 2011.
- Swift, Earl. 2011. *The Big Roads: The Untold Story of the Engineers, Visionaries, and Trailblazers Who Created the American Superhighways*. Boston: Houghton Mifflin Harcourt.
- Taylor, Brian D. 2000. When Finance Leads Planning: Urban Planning, Highway Planning, and Metropolitan Freeways in California. *Journal of Planning Education and Research* 20: 196-214.

- U.S. Bureau of the Census. 2011. *U.S. Statistical Abstract, 2011*. Washington, D.C.: U.S. Bureau of the Census, available at <http://www.census.gov/compendia/statab/>, accessed September 13, 2011.
- U.S. Environmental Protection Agency. 2011. Air Data: Access to Air Pollution Data. Available at <http://www.epa.gov/air/data/index.html>, accessed July 23, 2011.
- U.S. Federal Highway Administration (FHWA). No date a. "Financing Federal Aid Highways," <http://www.fhwa.dot.gov/reports/fifahiwy/fifahi05.htm>, accessed July 25, 2011.
- U.S. Federal Highway Administration. No date b. "Transportation Conformity: A Basic Guide for State and Local Officials." [http://www.fhwa.dot.gov/environment/air\\_quality/conformity/guide/guide01.cfm](http://www.fhwa.dot.gov/environment/air_quality/conformity/guide/guide01.cfm), accessed July 23, 2011.
- U.S. Federal Highway Administration (FHWA). 2011a. *The Trailblazers: Brief History of the Direct Federal Highway Construction Program*. Web site at <http://www.fhwa.dot.gov/infrastructure/blazer01.cfm>, accessed September 13, 2011.
- U.S. Federal Highway Administration (FHWA). 2011b. "Urban Transportation Planning in the United States: An Historical Overview", <http://tmip.fhwa.dot.gov/resources/clearinghouse/docs/utp/ch4.htm>
- Vickrey, William S. 1963. Pricing in Urban and Suburban Transport. *American Economic Review* 53: 452-465.
- Weiss, Eric M. 2008. Highway Trust Fund is Nearly Out of Gas. Washington Post, Sept. 6, available at <http://www.washingtonpost.com/wp-dyn/content/article/2008/09/05/AR2008090503525.html>, accessed July 18, 2011.
- Wheaton, William C. 1977. Residential Decentralization, Land Rents, and the Benefits of Urban Transportation Investment. *American Economic Review* 67,2: 138-143.