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An Economic Report to the Governor of the State of Tennessee

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PREFACE

This 2011 volume of An Economic Report to the Governor of the State of Tennessee is the thirty-fifth in a series of annual reports compiled in response to requests by state government officials for assistance in achieving greater interdepartmental consistency in planning and budgeting efforts sensitive to the overall economic environment. Both short-term, or business cycle-sensitive forecasts, and longer-term, or trend forecasts, are provided in this report.

The quarterly state forecast through the first quarter of 2013 and annual forecast through 2020 represent the collective judgment of the staff of the University of Tennessee’s Center for Business and Economic Research in conjunction with the Quarterly and Annual Tennessee Econometric Models. The national forecasts were prepared by Global Insight, Inc. Tennessee forecasts, current as of January 2011, are based on an array of assumptions, particularly at the national level, which are described in Chapter One. Chapter Two details evaluations for major sectors of the Tennessee economy, with an agriculture section provided by the University of Tennessee Agricultural Policy Analysis Center. Chapter Three presents the long-run outlook and forecast for the state. Chapter Four provides a discussion of the importance of transportation infrastructure to the state and its economic development.

The primary purpose of this annual volume—published, distributed, and financed through the Tennessee Department of Finance and Administration, Tennessee Department of Economic and Community Development, the Tennessee Department of Revenue, the Tennessee Department of Labor and Workforce Development, and the Appalachian Regional Commission—is to provide wide public dissemination of the most-current possible economic analysis to planners and decision-makers in the public and private sectors.

Matthew N. Murray
Associate Director and Project Director
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CHAPTER 4: PASSENGER AND FREIGHT MOBILITY IN TENNESSEE: AN ECONOMIC AND POLICY OVERVIEW

In this chapter—

4.1. Introduction

4.2. Transportation Networks, Use and Economic Importance
   Setting the Stage
   Tennessee’s Transport Networks and Their Uses
   The Economic Importance of Transportation
   The Metro—Rural Contrast

4.3. Tennessee’s Transport Networks—Projects, Policies and Funding
   Setting the Stage from a State Perspective
   The Federal Influence
   Metropolitan and Rural Community Influences
   A Summary of the Fiscal Setting
   Examples of Major Initiatives

4.4. Looking Toward the Horizon
   Distinguishing Between the Short-Run and the Long-Run
   Population Growth, Global Trade and Other Long-Run Factors
   Infrastructure Costs and Fiscal Realities

4.5. Concluding Thoughts

4.1. Introduction

Within any economy, there are four dominant elements – (1) the supply, education, employment, and compensation of labor, (2) the availability and relative price of capital (buildings, equipment, computers) (3) the physical environment, including climate, terrain, and access to both energy and non-energy resources, and (4) a system of transportation and communications for moving people, goods, and information. Nearly all economic policy is designed to seize on the strengths or remedy deficits in one of these core areas. It is, however, Tennessee’s ability to physically move both passengers and freight that is the focus of the current chapter. The transportation setting is laden with both opportunities and complexities. Tennessee’s current and attainable transport capacity is a readily identifiable asset within efforts to bring jobs and incomes to the state’s growing population. Few other states are better positioned. However, this opportunity comes with three notable challenges. First, to capture the potential benefits associated with the movement of people and goods, planners and policy-makers must understand how transportation works – both within the narrowly defined passenger and freight
4.1. Introduction, continued

movement sectors and within the broader economy. This understanding must extend to markets and populations that are, increasingly, thousands of miles away. Also, while understanding past economic realities is useful, maintaining a forward-looking vantage and a certain amount of flexibility is also critical to the transportation policy process.

The second challenge is to efficiently accommodate transport demands, while protecting the other attributes that define the quality of life in Tennessee communities. In some cases, this may mean segregating transportation activities from other aspects of community life. In other instances, it is necessary to carefully integrate mobility within communities in ways that simultaneously ensure efficient movement and preserve community “livability.”

Finally, Tennessee transportation programs and policies cannot escape the increasingly harsh fiscal realities that compound the difficulty of sustaining adequate transportation. Federal transport policy is currently gridlocked by the inadequacy of existing funding steams and the inability to identify sufficient forward-looking alternatives. Similarly, it is increasingly difficult for state governments to match federal resources where these are available and to undertake initiatives that have no federal component.

4.2. Transportation Networks, Use and Economic Importance

Setting the Stage

Transportation activities are tightly woven within the basic fabric of both daily life and regional commerce. They are integral to nearly everything we do. Furthermore, the overwhelming majority of transportation is affected with an ease and efficiency that leaves it completely unworthy of attention. Within Tennessee, we generate tens of millions of passenger trips and freight movements daily, but only under extraordinary circumstances – usually when someone or something fails – do transportation activities become our central focus.

Similarly, seemingly distinct elements are routinely combined to provide a single transport event (an end-to-end passenger or freight movement). Even something as simple as a trip to work can require driving, parking, transit, and a walk to the workplace, while a locally purchased pair of tennis shoes probably traveled thousands of miles by three or more distinct transport modes in order to span the distance between manufacturer and retailer. Generally, the integration of distinct transportation resources goes unnoticed if all components function properly.

These successes are the culmination of myriad interactions between vehicle manufacturers, passenger and freight service providers, builders, and public sector planners and policy-makers.

Policy and Planning Notes

The jurisdictional authority of state planners and policy-makers varies greatly from one transport mode to the next. Historically, state-level authorities have had their greatest power in the development, construction, and maintenance of roadways and this outcome is largely true today. The federal government retains substantial control over airline, railroad, and navigation facilities and operations. Still, state-level policy makers have an important role in guiding federal policy toward all transport modes and in assuring that all modal alternatives have efficient interconnectivity and community access via Tennessee’s roadway system.
4.2. Transportation Networks, Use and Economic Importance, continued

**Tennessee’s Transport Networks and Their Uses**

Recognizing and attending to the highly integrated nature of transportation resources is essential to successful transportation planning. At the same time, manageability sometimes requires the segregation of specific modes and/or uses for data gathering and limited analytical purposes. This is the course followed here.

**Roadways**

Tennessee’s roadway network is at the core of both passenger and freight transport within the state. Basic characteristics of this network are summarized in Table 4.1. Several points are worth noting. First, the amount of highway infrastructure per capita in Tennessee is very consistent with the national average. In very rural or very urbanized states, this is not the case. Second, based on the two performance measures considered here – the roadway condition rating and the percentage of bridges judged to be structurally adequate – Tennessee is measurably ahead of the national average. Finally, the data indicate that nationally, a higher percentage of roads are owned by either the state in question or the federal government than is the case in Tennessee. Readers are left to reach their own conclusions about whether the correlation between infrastructure condition and ownership is coincidental.

In 2009, this roadway network accommodated approximately 70 billion vehicle miles of travel that included both passenger vehicles and commercial trucks. Representative segment-specific roadway volumes vary immensely from several thousand vehicles per hour on busy urban Interstates to one or two vehicle every two or three minutes on quiet local roadways. On average, trucks account for between five and 15 percent of all vehicle miles. However, because of their size, they consume a disproportionately large amount of capacity and inflict measurably greater roadway damage.

---


**Table 4.1. Tennessee Roadways are its Transportation Backbone**

<table>
<thead>
<tr>
<th></th>
<th>Tennessee</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate (miles)</td>
<td>1,105</td>
<td>46,751</td>
</tr>
<tr>
<td>(Miles Per Capita X 1,000)</td>
<td>0.17550</td>
<td>0.15228</td>
</tr>
<tr>
<td>Arterials (miles)</td>
<td>9,215</td>
<td>412,037</td>
</tr>
<tr>
<td>(Miles Per Capita X 1,000)</td>
<td>1.46357</td>
<td>1.34211</td>
</tr>
<tr>
<td>Collectors (miles)</td>
<td>17,873</td>
<td>794,684</td>
</tr>
<tr>
<td>(Miles Per Capita X 1,000)</td>
<td>2.83867</td>
<td>2.58849</td>
</tr>
<tr>
<td>Local (miles)</td>
<td>63,982</td>
<td>2,789,306</td>
</tr>
<tr>
<td>(Miles Per Capita X 1,000)</td>
<td>10.16192</td>
<td>9.08549</td>
</tr>
<tr>
<td>Percent Rated Good or Very Good</td>
<td>63.9%</td>
<td>40.6%</td>
</tr>
<tr>
<td>Percent State-Owned</td>
<td>15.1%</td>
<td>19.3%</td>
</tr>
<tr>
<td>Percent Federally Owned</td>
<td>1.4%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Number of Bridges</td>
<td>19,939</td>
<td>601,126</td>
</tr>
<tr>
<td>Bridges per Mile</td>
<td>0.2163</td>
<td>0.1487</td>
</tr>
<tr>
<td>Percent Structurally Obsolete</td>
<td>6.2%</td>
<td>11.8%</td>
</tr>
</tbody>
</table>
4.2. Transportation Networks, Use and Economic Importance, continued

Most vehicle trips are relatively short. In Tennessee, the average commute to work is by car, over a 15 mile route that takes approximately 24 minutes. Average truck hauls range from 40 miles for private truck movements to approximately 550 miles for truck-load common motor carriage. By virtue of its location within the greater geographic highway network, roughly 60 percent of all trucks observed on Tennessee roadways have neither their origin nor destination within the state, but instead represent “pass-through” traffic.

Airline Travel and Air Freight

Tennessee is home to five commercially served airports – Memphis, Nashville, Knoxville, Chattanooga, and the Tri-Cities. Traffic and operational characteristics for these facilities is summarized in Table 4.2. There is very little that is surprising in this table’s values. FedEx operations at Memphis are readily apparent in the annual freight tonnage and daily operations tallies. Otherwise, traffic volumes are consistent with variations in populations observed among the metro communities served.

Passenger Railroad Operations

Currently, Tennessee has minimal passenger railroad operations. Amtrak operates one daily train in each direction between Chicago and New Orleans that makes stops in both Dyersburg and Memphis and commuter rail operations link Lebanon, Mount Juliet and a number of intermediate points with Nashville’s city center.

In keeping with the recent resurgence in passenger rail planning, the Tennessee Department of Transportation (TDOT) has just completed an update to the passenger rail portion of its State Rail Plan. This update carefully examines available alternatives for creating both high-speed and traditional passenger rail corridors serving a number of Tennessee’s communities. However, there are no immediate plans to carry these efforts beyond the planning stage.

Freight Railroads

Of the seven Class I railroads currently operating in the U.S., six maintain trackage and facilities in Tennessee. Only the Canadian Pacific does not have a presence in the state. This said three of the six (BNSF, Kansas City Southern, and Union Pacific) each operate less than 20 miles of Tennessee trackage and the Canadian National operates less than 200 route miles within the state. Most in-state railroad track is owned and operated by the nation’s two dominant eastern carriers CSX Transportation (CSXT) and Norfolk Southern (NS). Both CSXT and NS operate roughly 1,000 miles of railroad within Tennessee’s borders.

A substantial amount of rail traffic to and from the state enters through the rail gateways of Memphis and Chattanooga (via Atlanta). Four of the six Class I’s serving Tennessee (BNSF, CN, CSX, and NS) operate major terminal facilities in Memphis and a fifth (UP) operates a large intermodal terminal nearby in Marian, Arkansas. Only the KCS lacks a Memphis presence. At the eastern end of the state, where CSXT and NS dominate, each carrier operates multiple terminal facilities in Atlanta and both funnel millions of tons annually over routes that converge and diverge at Chattanooga.

Policy and Planning Notes

The current trend among both airlines and regulators is toward consolidation of commercial activity at a smaller number of somewhat larger regional airports. This trend will be particularly important as federal authorities develop and implement the “next generation” of GPS-based air traffic control. While these activities fall outside state jurisdictions, individual airports and groups of airport users are likely to seek state-level for support for a variety of positions.

2 In addition to facilities in Memphis and Chattanooga, CSXT operates classification yards in both Nashville and Erwin, Tennessee and an intermodal terminal at Nashville. NS operates a classification yard at Knoxville and has announced plans for a new intermodal facility also to be located in east Tennessee.
4.2. Transportation Networks, Use and Economic Importance, continued

Finally, in addition to Tennessee’s Class I rail carriers, the state is also served by 22 short-line carriers that operate a total of more than 800 miles of track. Unlike the Class I railroads, Tennessee’s DOT provides annual funding to short-line carriers that is used to improve both bridge and track quality. This funding is distributed via locally created and administered rail authorities that interact with TDOT on an ongoing basis. The whole of this process creates a fiscal linkage between the state and the short-lines that does not exist with the Class I railroads.

Table 4.3 summarizes rail traffic that originates or terminates in Tennessee. Inbound shipment volumes (primarily coal) roughly double outbound traffic. Intermodal shipping has grown substantially within state and is expected to increase even more rapidly over the coming decades as both international and domestic container movements to and from the state increase. As discussed further below, access to price-competitive intermodally shipped imports is likely to remain an important interest area for policy-makers and planners.

In addition to coal and intermodal movements, freight rail continues to play an important role in the agricultural sector, serving as both a source of and an outlet for farm products and many of the chemicals that are used in the growing and processing sectors. Paper and paper products also depend notably on rail service. Finally, rail traffic volumes are rounded out by the movement of building products such as wood and lumber, concrete and its components, and the stone, sand, and gravel often used as base products.

Table 4.2. FedEx Operations Color Air Traffic Figures

<table>
<thead>
<tr>
<th></th>
<th>Memphis (MEM)</th>
<th>Nashville (BNA)</th>
<th>Knoxville (TYS)</th>
<th>Chattanooga (CHA)</th>
<th>Tri-Cities (TRI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily Operations</strong></td>
<td>915</td>
<td>477</td>
<td>283</td>
<td>154</td>
<td>140</td>
</tr>
<tr>
<td><strong>Non-Stop Destinations</strong></td>
<td>90</td>
<td>48</td>
<td>22</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Annual Boardings</strong></td>
<td>5,054,191</td>
<td>4,385,780</td>
<td>811,379</td>
<td>311,399</td>
<td>217,783</td>
</tr>
<tr>
<td><strong>Annual Airfreight (tons)</strong></td>
<td>9,464,365</td>
<td>177,883</td>
<td>NQ</td>
<td>NQ</td>
<td>NQ</td>
</tr>
<tr>
<td><strong>Max Runway Length (feet)</strong></td>
<td>11,120</td>
<td>11,030</td>
<td>9,005</td>
<td>7,400</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>Airport Airspace Class</strong></td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

1 NQ denotes “Non-Qualifying,” an indication that annual freight volumes fall below the threshold above which records are reported.
2 Airspace classifications are based on the altitude below which aircraft fall under the direct control of controllers, as well as the range of both required and available instrument procedures. Generally, they denote both capacity and traffic volumes.

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Policy and Planning Notes

Tennessee is one of five states that has formally supported Norfolk Southern (NS) improvements to the Crescent Corridor – a network of freight rail lines connecting the mid-Atlantic region with various locations in the south and southeast. These improvements are intended to divert domestic truck traffic from the Interstate system to the rail-truck intermodal routing. Within the context of this initiative, NS is working with the state to develop new intermodal truck-rail facilities in Fayette County, near Memphis, and in Jefferson County, near Knoxville.

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4.2. Transportation Networks, Use and Economic Importance, continued

Commercial Navigation

Tennessee’s western border is largely formed by the lower Mississippi River which is a free-flowing waterway, typically supporting 30-barge freight tows.\(^4\) Commercial navigation is also available on the Tennessee and Cumberland Rivers. However, navigation (and other river uses) is supported by navigation structures (primarily locks and dams) that help maintain channel depths by creating reservoirs that are also referred to as pools. The presence of these navigation structures, combined with channel width, causes tow sizes to become increasingly smaller as shipment on either river system move upstream, away from their confluence with the Ohio River. Table 4.4 provides information describing the lock and lock performance on both the Tennessee and the Cumberland.

Planning, construction, and river operations on the Mississippi River fall strictly under the control of the U.S. Army Corps of Engineers (Corps). On the Tennessee and Cumberland Rivers, these responsibilities are divided between the Corps and the Tennessee Valley Authority (TVA). Vessel requirements and operations on all three rivers are controlled by the U.S. Coast Guard. Accordingly, the primary role of state policies is to inform the federal decision-makers and influence land-side accesses and uses.

The Economic Importance of Transportation

Individual mobility and the movement of goods are integral to all we do. Thus, the quality of life for all Tennesseans, as well as the vitality of commerce depends on available, safe, and affordable transportation. The dollar values of the various types of transportation, sets of transportation users, and transportation service characteristics evidenced within the state can be measured in many different ways.

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\(^4\) In actuality, the border is formed by what once was the course of the Mississippi. Consequently, natural course changes in the river have isolated small portions of Arkansas and Kentucky in what appears to be Tennessee and small portions of Tennessee in what appears to be Arkansas and Kentucky. This outcome is common throughout the inland navigation and results in some very interesting jurisdictional issues.

---

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Originating Traffic</th>
<th>Terminating Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermodal Shipments</td>
<td>2,760,560</td>
<td>2,893,840</td>
</tr>
<tr>
<td>Farm Products</td>
<td>731,440</td>
<td>4,361,288</td>
</tr>
<tr>
<td>Coal</td>
<td>1,299,528</td>
<td>10,018,051</td>
</tr>
<tr>
<td>Stone and Gravel</td>
<td>------</td>
<td>988,496</td>
</tr>
<tr>
<td>Food Products</td>
<td>1,871,728</td>
<td>3,895,812</td>
</tr>
<tr>
<td>Lumber and Wood Products</td>
<td>------</td>
<td>1,084,720</td>
</tr>
<tr>
<td>Pulp, Paper and Paper Products</td>
<td>1,416,264</td>
<td>1,380,700</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1,612,640</td>
<td>4,743,216</td>
</tr>
<tr>
<td>Concrete, Cement, etc.</td>
<td>1,798,136</td>
<td>------</td>
</tr>
<tr>
<td>Scrap Materials</td>
<td>793,876</td>
<td>------</td>
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<tr>
<td>Other Commodities</td>
<td>3,207,080</td>
<td>4,018,514</td>
</tr>
<tr>
<td>TOTAL</td>
<td>15,491,252</td>
<td>33,384,637</td>
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</tbody>
</table>
4.2. Transportation Networks, Use and Economic Importance, continued

In the aggregate the dollar results are large. Each year, Tennessee households spend roughly $25 billion (18 percent of available income) on the purchase of transportation goods and services. Of this amount, the vast majority (93 percent) is spent to purchase, service, fuel, and insure automobiles. Tennessee businesses also spend to buy transportation (and related) services. These business expenditures total roughly $8 billion annually. Finally, Tennesseans produce transportation vehicles, vehicle accessories, and vehicle parts. Each year, the total value added within this category is roughly $18 billion (six percent) of the state’s annual $250 billion Gross Domestic Product.

The Value of Passenger Vehicle Transport

Each day in Tennessee, passenger vehicles produce roughly 172 million Vehicle Miles Traveled (VMT). Of this amount, slightly less than 20 percent (34 million) represent trips to and from work. Another 26 percent (45 million VMT) is made up of household errands and recreational travel. On average, each of the vehicle trips that contribute to these totals includes a driver and 0.59 passengers. Combining these figures, Tennessee drivers accrue something like 275 million passenger vehicle miles per day.

Converting passenger miles to a corresponding value for roadway improvements requires an assumption and the application of an arbitrarily determined value. However, as speculative as this may seem, it is equally instructive. If we assume that the average vehicle speed is 34 mph.

Table 4.4. Infrastructure Is Critical to Navigation on the Tennessee and Cumberland Rivers

<table>
<thead>
<tr>
<th>Project Name</th>
<th>River Mile</th>
<th>Main Chamber Size (feet)</th>
<th>Average Lift (feet)</th>
<th>Typical Delay (minutes)</th>
<th>Typical Annual Freight (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky</td>
<td>22.4</td>
<td>600X110</td>
<td>63</td>
<td>263</td>
<td>32.0</td>
</tr>
<tr>
<td>Pickwick</td>
<td>206.7</td>
<td>1000X110</td>
<td>96</td>
<td>32</td>
<td>19.6</td>
</tr>
<tr>
<td>Wilson</td>
<td>259.4</td>
<td>600X110</td>
<td>45</td>
<td>43</td>
<td>12.8</td>
</tr>
<tr>
<td>Wheeler</td>
<td>274.9</td>
<td>600X110</td>
<td>35</td>
<td>32</td>
<td>8.7</td>
</tr>
<tr>
<td>Guntersville</td>
<td>349.0</td>
<td>600X110</td>
<td>39</td>
<td>&lt;30</td>
<td>4.9</td>
</tr>
<tr>
<td>Nickajack</td>
<td>424.7</td>
<td>600X110</td>
<td>50</td>
<td>85</td>
<td>2.3</td>
</tr>
<tr>
<td>Chickamauga</td>
<td>471.0</td>
<td>360X60</td>
<td>60</td>
<td>49</td>
<td>1.6</td>
</tr>
<tr>
<td>Watts Bar</td>
<td>529.9</td>
<td>360X60</td>
<td>72</td>
<td>&lt;30</td>
<td>0.6</td>
</tr>
<tr>
<td>Fort Loudon</td>
<td>602.3</td>
<td>360X60</td>
<td>72</td>
<td>&lt;30</td>
<td>0.6</td>
</tr>
<tr>
<td>Barkley</td>
<td>30.6</td>
<td>800X110</td>
<td>57</td>
<td>&lt;30</td>
<td>3.6</td>
</tr>
<tr>
<td>Cheatham</td>
<td>148.7</td>
<td>800X110</td>
<td>26</td>
<td>&lt;30</td>
<td>8.4</td>
</tr>
<tr>
<td>Old Hickory</td>
<td>216.2</td>
<td>428X84</td>
<td>60</td>
<td>&lt;30</td>
<td>3.6</td>
</tr>
</tbody>
</table>

5 The data here do not account for passenger vehicles operated by drivers from other states. Similarly, they do not account for the miles driven by Tennesseans in other states.
4.2. Transportation Networks, Use and Economic Importance, continued

Transportation and related expenditures are relatively high in industries where physical inputs and outputs are most important and low in industries where this is not the case.

The Value of Freight Transportation

Unlike passenger transport, freight movement in Tennessee is not wholly dominated by highway activity. Motor carriage still accounts for the great majority of freight moved when freight is measured by its value. However, when tons are substituted as the output measure, the division of shares between truck and rail is somewhat more balanced. Finally, commercial navigation is also an important contributor to freight movements in Tennessee. Freight shares by both measures are included in Table 4.5.

Table 4.5. Trucks Dominate Freight Movements

<table>
<thead>
<tr>
<th></th>
<th>Value (2007 $millions)</th>
<th>Tons (2007 thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INBOUND Interstate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>161,564</td>
<td>74,372</td>
</tr>
<tr>
<td>Rail</td>
<td>14,733</td>
<td>33,387</td>
</tr>
<tr>
<td>Barge</td>
<td>3,246</td>
<td>9,522</td>
</tr>
<tr>
<td><strong>OUTBOUND Interstate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>293,210</td>
<td>114,756</td>
</tr>
<tr>
<td>Rail</td>
<td>8,141</td>
<td>15,491</td>
</tr>
<tr>
<td>Barge</td>
<td>1275</td>
<td>5782</td>
</tr>
<tr>
<td><strong>Intrastate Tennessee</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck</td>
<td>104,259</td>
<td>249,548</td>
</tr>
<tr>
<td>Rail</td>
<td>846</td>
<td>810</td>
</tr>
<tr>
<td>Barge</td>
<td>201</td>
<td>374</td>
</tr>
</tbody>
</table>

Table 4.6 disaggregates estimated total business transportation and warehousing expenditures by industrial sector and also provides an estimate of transportation’s importance relative to other production inputs. These data offer no surprises.

6 These values were developed based national Bureau of Economic Analysis (BEA) Input-Output tables that relate output production to input usage. National numbers were adjusted to reflect state-specific variations as identified within location quotients.

The Metro – Rural Contrast

Whether discussing passenger or freight transportation, it is clear that the demand for transportation infrastructure and its corresponding use are both highly correlated with where people live and work. Passenger movement is highly localized and freight carriage is more localized than is commonly perceived. To the extent that transport networks transit lightly populated areas it is only because such routings are necessary to connect places where residential and commercial activities are more plentiful.

Within Tennessee, there are nine Metropolitan Statistical Areas (MSA’s) that consist of 38 Tennessee counties and a handful of counties in Arkansas, Kentucky, Georgia, Mississippi, and Virginia. Focusing on the Tennessee counties, 72 percent of the state’s population and 78 percent of its income reside within these metro areas. Even restricting the calculations to the nine core MSA counties (Shelby, Davidson, Knox, etc.), metro centers account for half (48 percent) of the state’s population and half (52 percent) of its incomes.

From a physical standpoint, half of the transportation demand within the state resides in areas that occupy only about 11 percent of the land area or, conversely, less than 30 percent of the demand factors associated with transportation are located in areas that occupy more than 60 percent of Tennessee’s physical jurisdiction.

The concentration of local demands in metro areas is compounded by their frequent role as network junction points, the presence of pass-through traffic that neither originates nor terminates in the state, and the need to move freight traffic from one mode to another at such locations. The sum of these effects is a need for transportation infrastructure development in metro areas that is vastly greater than any corresponding need in more rural communities.
4.2. Transportation Networks, Use and Economic Importance, continued

Table 4.6. Transportation Is an Important Business Input

<table>
<thead>
<tr>
<th>Industrial Sector</th>
<th>Transportation / Warehousing Expenditures (2009 $millions)</th>
<th>Percentage of Total Sector Input Expenditures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag., Forestry, Etc.</td>
<td>47.62</td>
<td>4.1%</td>
</tr>
<tr>
<td>Mining</td>
<td>24.66</td>
<td>3.5%</td>
</tr>
<tr>
<td>Utilities</td>
<td>88.86</td>
<td>7.4%</td>
</tr>
<tr>
<td>Construction</td>
<td>230.35</td>
<td>2.4%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1,510.92</td>
<td>3.7%</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>949.59</td>
<td>5.6%</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>979.57</td>
<td>4.8%</td>
</tr>
<tr>
<td>Transport and Warehousing</td>
<td>1,687.01</td>
<td>13.2%</td>
</tr>
<tr>
<td>Information</td>
<td>199.62</td>
<td>2.4%</td>
</tr>
<tr>
<td>Financial Sector</td>
<td>276.54</td>
<td>0.7%</td>
</tr>
<tr>
<td>Prof. and Busn. Services</td>
<td>568.98</td>
<td>2.0%</td>
</tr>
<tr>
<td>Education, Health Care, Etc.</td>
<td>332.84</td>
<td>1.3%</td>
</tr>
<tr>
<td>Arts, Rec, Food and Lodging</td>
<td>185.6</td>
<td>1.7%</td>
</tr>
<tr>
<td>Other Private Sector Services</td>
<td>122.79</td>
<td>1.8%</td>
</tr>
<tr>
<td>Government Services</td>
<td>672.47</td>
<td>2.4%</td>
</tr>
<tr>
<td>TOTAL / AVERAGE</td>
<td>7,877.42</td>
<td>3.8%</td>
</tr>
</tbody>
</table>

Rural policymakers counter that improved transportation capacity is needed to spur rural economic development. However careful examination suggests that nearly all rural areas have local transportation facilities that are more than adequate to meet foreseeable demands. Moreover, evidence suggests that the addition of transportation infrastructure, in the absence of other productive inputs, has very little impact on either jobs or incomes in rural communities. Finally, the reliability impacts of metro area congestion on traffic to and from rural communities are likely to be at least as important to rural economic development as any localized issues. Quite simply, improved network mobility in metropolitan settings, enhances transportation efficiency in all Tennessee communities, both large and small.

Policy and Planning Notes

The relationship between available transportation and rural economic conditions is complex. First, there is mounting evidence that transportation improvements, in isolation, have little or no positive influence on economic outcomes. Moreover, congestion in metro areas can substantially disrupt transportation to and from nearby rural communities. Together, these outcomes suggest that any focus on improving rural transportation infrastructure that detracts from metropolitan mobility may hurt rural areas far more than it helps them. This conclusion, however, certainly does not have universal acceptance.

7 To a large extent the adequacy of rural transportation infrastructures is the direct result of previous state actions that have improved highway access through the County Seat Connector Initiative and through the state’s short-line rail programs.
Setting the Stage from a State Perspective

From a practical standpoint, TDOT is the nexus for most transportation policy and policy implementation. Roadway transport is paramount to both passenger and freight mobility within the state and TDOT directly influences the planning, construction, operation, and maintenance of nearly every important roadway segment. Even in the case of non-highway modes, where federal influence prevails, TDOT is typically the venue in which federal guidance for aviation, rail carriage, and barge transportation is integrated into the plans that most greatly impact specific Tennessee communities.

While TDOT is at the center of transportation planning and implementation, it does not dominate these processes. Instead, its role is divided between instigator and facilitator. Very clearly, numerous infrastructure and policy initiatives emerge directly from TDOT monitoring and planning activities. However, just as often TDOT work reflects a response to externally developed programs as expressed by either the federal government or by more locally-focused regional planning groups. This pivotal role is depicted graphically in Figure 4.1.

The Federal Influence

The daily concerns of most Tennesseans tend to focus on local transportation needs – getting to and from work or school, getting building materials delivered to a job site, etc. In reality, however, our well-being is equally if not more greatly influenced by the ability to connect the state’s communities and regions to the remainder of the continent and to the global markets that lie beyond. Assuring the availability and affordability of this greater connectivity is the responsibility of the federal government. Additionally, it is the federal government that has assumed the primary role in developing and enforcing the standards deemed necessary to environmental quality and public safety. The execution of the tasks that result from these responsibilities colors nearly every aspect of local and regional transportation decision-making within the state.

Roadway Network Design and Funding

Roughly one-third of every dollar spent on roadway construction and maintenance in Tennessee is derived through federal revenue streams – primarily fuel taxes. In providing these funds, the federal government also provides guidance regarding both the nature and extent of resulting highway projects. In the case of the Interstate System and its component roadways, this guidance is relatively strict. However, federal influence on both the location and nature of roadways financed under other portions of the federal highway program are less restrictive and subject to considerably greater state and local input

Non-Highway Networks and Operations

The federal government has historically been willing to share jurisdictional control of roadway network design and operations with state and local governments. This has been far less the case with non-highway modes. Instead, the federal government has maintained strict control over airspace, airports, railroad infrastructure, and inland navigation structures and operations. Airspace, airport development, related ground operations, pilot licensing, and aircraft maintenance are all tightly controlled by the Federal Aviation Administration (FAA). Other than offering input into the development and maintenance of smaller, general aviation (GA) airports and providing highway and transit access to larger, commercially served airports, the state has little jurisdiction.

The same is generally true of commercial inland navigation. The scope, scale, and operations of navigation facilities (principally, locks and dams) remain under the direct control of the U.S. Army Corps of Engineers, while river operations fall under the
4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

First, railroad deregulation during the 1970s and 1980s lead to a number of short-line “spin-offs” that are largely intrastate in their operations. Tennessee has embraced these small railroads through its TDOT-administered short-line programs which provide a modest amount of funding on an annual basis through regionally-created rail authorities.

More recently, the larger (Class I) railroads have enlisted and received direct state support for the development of improved freight infrastructures.10 For example, Tennessee has joined with four other eastern and southeastern states in support of the Crescent Corridor initiative – a series of improvements planned by Norfolk Southern to enhance intermodal truck-rail connectivity between the northeast and deep south. In some instances, state support has been limited to highway access, grade crossing improvements,

9 The exception to this outcome lies in TVA. TVA’s primary mission is increasingly limited to the generation and distribution of electric power. However, it also directly controls water releases on the Tennessee and Cumberland Rivers in support of commercial navigation, recreation, and flood control. TVA is a federally-created, quasi-federal entity that does not fit easily into the traditional jurisdictional taxonomy.

10 Railroad “Class” is determined by the STB based on annual operating revenues. Currently, the Class I threshold is set at $250 million per year.
CHAPTER 4  |  Passenger and Freight Mobility In Tennessee: An Economic and Policy Overview

4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

and terminal developments. In other cases (particularly in Virginia), states have provided grant funds to affect line-haul track segment improvements. Overall Crescent Corridor improvements, including two new Tennessee intermodal terminals in Fayette and Jefferson County are depicted in Figure 4.2.

Vehicle Safety and Emissions Standards and Enforcement
The federal government establishes minimum safety and emission standards for nearly all transportation vehicles. In the case of passenger vehicles and on-road trucks, Tennessee participates in the enforcement of these standards. For all other transportation vehicles (aircraft, locomotives, rail cars, commercial vessels, etc.) safety and emission standards are enforced by the federal government only.

General Environmental Standards and Enforcement
The development of transportation infrastructures and the operation of transportation vehicles over these infrastructures has observable impacts on air quality, water quality and animal habitats. Evaluating the extent of these impacts within the permitting process and imposing mitigation measures is largely the responsibility of the federal government via the Environmental Protection Agency’s enforcement of the National Environmental Protection Act, the Clean Water Act, etc. However, the state of Tennessee is expected to participate as a full partner in these efforts.

Metropolitan and Rural Community Influences
The federal statute that authorizes highway grant funding for individual states also requires that these states engage both metropolitan and rural planning organizations within the highway planning process. In the case of metropolitan planning, the statute actually segregates a certain amount of funds for metro spending. Metropolitan Planning Organizations (MPO’s) develop requests as a part of their Transportation Investment Plans (TIP’s). These plans are then included in state’s aggregation of requests contained in the State Transportation Investment Plan (STIP). Rural Planning Organizations do not have the direct capacity to program funding for future projects. However, their needs (as often documented in TDOT-sponsored studies) are evaluated with other proposed highway projects, based on the same criteria applied to internally generated TDOT proposals.

Policy and Planning Notes
While the federal government adopts authorizing legislation roughly once each decade, this legislation generally fails to reflect any long-range, comprehensive transportation policy. Instead, it is oriented toward system funding and other specific transport-related topics that are, for the moment, judged as important (the environment, transport security, intermodal freight, etc.).

Currently, a new round of federal policy and funding is overdue. Speculation suggests that it will continue the federal emphasis on intermodal transport, focus on multi-state “corridor” analyses, and relative project benefits and costs. This latter fact is aimed at addressing some of the difficult fiscal realities that have been ignored by earlier legislation.

Whether rural or metropolitan, local communities are very sensitive to their treatment within the transportation planning process. Thus, in addition to federally-mandated community involvement, Tennessee’s legislature will, from time to time, directly intervene. The current “County Seat Connector” program mandating four-lane highway access to each of Tennessee’s 95 county seats is a powerful example of direct legislative engagement on the behalf of community advocates.
4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

A Summary of the Fiscal Setting

In very rough terms, the state of Tennessee and its local communities spent about $2.5 billion on roadway construction and maintenance in 2007. Of this sum, approximately $1 billion was federal funds returned through federal fuel tax collections, while the remaining $1.5 billion was state money developed almost exclusively through state-imposed vehicle fuel taxes and vehicle registration fees. Of the total, approximately $1.2 reflected revenues and planned expenditures from earlier budget years. A stylized summary of transportation revenues and expenditures for 2007 – 2008, excluding the carry-over amounts, is provided Table 4.7.

These data prompt three preliminary, but extremely important points. First, depending on how one accounts for the federal portion of Tennessee’s annual roadway expenditures, non-roadway spending accounts for only three - five percent of the state’s annual total budget outlays. Thus, while transportation infrastructure is critical to the well-being of all Tennesseans, it comes with a relatively modest price tag compared to other spending

Policy and Planning Notes

This chapter makes reference to the “County Seat Connector” (CTC) initiative as an example of direct legislative guidance within Tennessee’s transportation planning processes.

The CTC program is a generation-long effort to see that the county seat within each Tennessee county has efficient and reliable highway access. To date, TDOT has constructed (or is currently developing) connectors in 75 of 95 counties. Unfortunately, a number of the remaining connectors where no work has occurred are in areas where challenging terrain will result in extremely costly construction efforts. Accordingly, TDOT, with the legislature’s advice, is further exploring available alternatives.
4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

Next, unlike many state’s Tennessee does not routinely incur bonded debt in order to undertake highway infrastructure projects. This practice is dubbed, “Pay As You Go.” (PAYGO)\textsuperscript{11} It is deliberate policy with clear outcomes. Finally, combining Table 4.7 data with other expenditure information, leads to the inescapable conclusion that Tennessee’s fiscal support for transportation is almost exclusively confined to roadway construction and maintenance. Annual expenditures for aviation, rail, waterway, or intermodal infrastructure projects total less than five percent of the amount spent on roadways each year.

Table 4.8 outlines the ways in which TDOT disbursed federally provided highway funds in 2007. It also provides a limited comparison to the averages across all other states. Again, there are two immediately obvious observations that reflect long-standing underlying philosophies.

First, the percentage of total disbursements targeted toward capital spending on state-administered roadways is measurably higher in Tennessee (compared to the national average). This difference is very similar in magnitude to the proportion of federal funds that Tennessee does not use to support construction-related debt (8.1 percent v. 8.9 percent). Thus, this difference reflects the Pay-As-You-Go-policy.

Table 4.8 also reflects a Tennessee approach toward local roadways that varies measurably from many other states. TDOT’s direct expenditures for local roads and streets are very nearly zero, whereas, other state DOT’s spend considerable amounts. Conversely, the percentage of federal funds that TDOT grants to local governments for their own disposition

\textsuperscript{11} The Pay-As-You-Go philosophy that governs roadway construction in Tennessee is the direct result of a barely-survived fiscal catastrophe in the 1930’s that was directly attributable to state bonding for the purpose of roadway construction. This said, the state does retain bonding authority that plays a role in TDOT’s budgeting and cash management process.

<table>
<thead>
<tr>
<th>Expenditures</th>
<th>Combined Federal And State Expenditure</th>
<th>Precent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Administration Expenses</td>
<td>$145,625,000</td>
<td>8%</td>
</tr>
<tr>
<td>State-Only Construction</td>
<td>$87,763,000</td>
<td>5%</td>
</tr>
<tr>
<td>Mas Transit Projects</td>
<td>$144,225,000</td>
<td>8%</td>
</tr>
<tr>
<td>Total Federal-Aid Construction</td>
<td>$1,197,116,200</td>
<td>69%</td>
</tr>
<tr>
<td>TOTAL D.O.T. (2007-2008)</td>
<td>$1,747,240,200</td>
<td>100%</td>
</tr>
<tr>
<td>Revenues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highway User Taxes</td>
<td>$662,800,000</td>
<td>38%</td>
</tr>
<tr>
<td>Misc. Dept. Revenues</td>
<td>$19,800,000</td>
<td>1%</td>
</tr>
<tr>
<td>Fund Balance &amp; Reserves</td>
<td>$12,000,000</td>
<td>1%</td>
</tr>
<tr>
<td>Bond Authorization</td>
<td>$83,800,000</td>
<td>5%</td>
</tr>
<tr>
<td>Transportation Equity Fund</td>
<td>$47,000,000</td>
<td>3%</td>
</tr>
<tr>
<td>Transfer to General Fund</td>
<td>$0</td>
<td>0%</td>
</tr>
<tr>
<td>Transfer from General Fund</td>
<td>$15,061,200</td>
<td>1%</td>
</tr>
<tr>
<td>Federal Funding</td>
<td>$906,779,000</td>
<td>52%</td>
</tr>
<tr>
<td>TOTAL REVENUE</td>
<td>$1,747,240,200</td>
<td>100%</td>
</tr>
</tbody>
</table>
4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

is half-again greater than the national average. This suggests Tennessee policy favors some degree of local autonomy over more centralized control.

The final table within this section (Table 4.9) divides expenditures between rural and metropolitan areas. These data suggest that capital expenditure aggregations based on this distinction point to a fairly even distribution of capital expenditures and a division of maintenance expenditures that is heavily weighted toward rural areas.

Examples of Major Initiatives

On any day, there are several hundred transportation projects at various stages of planning, development, or construction within the state. Most of these projects are relatively small and are distributed (more or less) evenly across the state. At the same time, observers can usually find a handful of larger, ongoing initiatives that quite understandably dominate public attention. These larger projects are generally intended to address long-standing and significant mobility or safety concerns. By virtue of their small number and large budgets, these large projects may appear to favor one region or another. However, an examination of large project selection over time suggests that they are also evenly distributed across the state’s major regions.

Projects At or Near Completion

Perhaps the most visible roadway project to be recently completed was SmartFIX40. This Knoxville area project involved lane additions and modernization to I-40 between I-275 and the Cherry Street exit. The project added one through lane in each direction to I-40 bringing it to a total of six lanes. Auxiliary lanes also were added between I-275 and James White Parkway and between Broadway and Cherry Street. Hall of Fame Drive was reconstructed as part of the project as a new four-lane city street. The project lasted from July 2005

Table 4.8. TDOT Disbursements of Federal Funds (2007)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Disbursement ($thousands)</th>
<th>Percent of Total (Tennessee)</th>
<th>Percent of Total (US Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Spending – State Administered Roads</td>
<td>930,209</td>
<td>56.1%</td>
<td>48.0%</td>
</tr>
<tr>
<td>Capital Spending – Local Roads and Streets</td>
<td>21,367</td>
<td>1.3%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Maintenance Spending – State Administered Roads</td>
<td>246,227</td>
<td>14.9%</td>
<td>15.4%</td>
</tr>
<tr>
<td>Maintenance Spending – Local Roads and Streets</td>
<td>-</td>
<td>0.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Administration, Research, and Planning</td>
<td>143,910</td>
<td>8.7%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Highway Law Enforcement</td>
<td>36,880</td>
<td>2.2%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Interest Paid</td>
<td>-</td>
<td>0.0%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Sinking Funds (Payments and Receipts)</td>
<td>-</td>
<td>0.0%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Bond Refunding</td>
<td>-</td>
<td>0.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Grants to Local Governments</td>
<td>278,900</td>
<td>16.8%</td>
<td>11.2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,657,493</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3. Tennessee’s Transport Networks—Projects, Policies and Funding, continued

Table 4.9. Rural / Metro Expenditures (2007) Are Evenly Divided

<table>
<thead>
<tr>
<th></th>
<th>Interstate</th>
<th>Other Principal Arterial</th>
<th>Minor Arterial</th>
<th>Major Collector</th>
<th>Minor Collector</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CAPITAL EXPENDITURES ($thousands)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>51,444</td>
<td>173,522</td>
<td>223,845</td>
<td>61,705</td>
<td>4,192</td>
<td>514,708</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>158,001</td>
<td>-</td>
<td>142,765</td>
<td>132,408</td>
<td>12,847</td>
<td>446,021</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>209,445</strong></td>
<td><strong>173,522</strong></td>
<td><strong>366,610</strong></td>
<td><strong>194,113</strong></td>
<td><strong>17,039</strong></td>
<td><strong>960,729</strong></td>
</tr>
<tr>
<td><strong>MAINTENANCE EXPENDITURES ($thousands)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>37,805</td>
<td>60,488</td>
<td>95,773</td>
<td>7,561</td>
<td>-</td>
<td>201,627</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>25,203</td>
<td>-</td>
<td>10,081</td>
<td>15,122</td>
<td>-</td>
<td>50,406</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>63,008</strong></td>
<td><strong>60,488</strong></td>
<td><strong>105,854</strong></td>
<td><strong>22,683</strong></td>
<td>-</td>
<td><strong>252,033</strong></td>
</tr>
</tbody>
</table>

through June 2009 during which time I-40 in downtown Knoxville was completely closed for 13 months to allow for an accelerated project schedule. The total estimated project cost was $190 million, making this the single largest modernization effort in TDOT’s history. In addition to the improvements that were a direct part of SmartFIX, significant advance improvements were made to I-640 in Knoxville so that it could effectively serve as a detour during I-40’s closure.

A series of I-40 – Briley Parkway interchange improvements immediately east of Nashville also represent the completion of a significant TDOT initiative. Briley Parkway provides access to the Opry Mills complex and several other destinations; it also serves as an effective bypass to Interstate routings through downtown Nashville. By virtue of its importance, the I-40 – Briley interchange must accommodate more than 40,000 vehicles each day. Historically, deficiencies in the capacity of this interchange have contributed to delayed travel for the more than 100,000 vehicles that use I-40 in this area each day. The Briley improvements include two large fly-overs and other improved connections, as well as interchange improvements at Briley Parkway – Elm Hill Pike interchange that were necessary to assure smooth Briley traffic flows to and from I-40.

At the western end of Tennessee, TDOT, in partnership with Arkansas’ Department of Transportation, is well under way in its $175 million seismic retrofit of the I-40, Hernando DeSoto Bridge. Upon completion, the retrofit (which includes both pier modifications and the installation of seismic expansion joints) is designed to ensure that the bridge and its approaches will be capable of withstanding an earthquake of a 7.7 (or less) magnitude. The partnering states are responsible for 80 percent of the total costs.

The projects noted above have received considerable visibility via both local and national media. However, they represent only three examples of numerous (albeit, smaller) highway projects to recently be completed. A representative list includes (Region 1) additional I-40 construction near Knoxville and work on US-25E; (Region 2) I-75 construction north of Chattanooga, US 27 construction north of Dayton, modifications of US-64 in Lincoln County, and US-70 construction near Dowelltown; (Region 3) I-65 improvements in the area of SR-273, I-24 construction between SR-10 and US-231, I-40 work in the vicinity of Briley Parkway, the completion of the Waverly

4.4. Looking Toward the Horizon

Distinguishing Between the Short-Run and the Long-Run

Most major transportation infrastructures will last for at least 20 years without any need for major redesign or rehabilitation. Given that the lead time for such projects is often ten years, planners and policy-makers must routinely try to look 30 years or more into the future when evaluating the worthiness of a large proposed project. For this reason, major transportation projects rely on a great deal of speculation about future economic and demographic conditions.

In most cases, absent major construction, there are usually incremental measures that can provide some relief to transportation users faced with declining mobility. These short-run fixes are, however, often quickly exhausted, leading to further incremental improvements in a succession of “band-aids” and a general sense of frustration among users who want a permanent solution.

Unfortunately for road-weary motorists, airline passengers, or commuters, the economics are squarely in favor of finding and executing short-run, smaller-scale solutions to transportation infrastructure problems. This is true for four reasons. First, the costs of large-scale infrastructure improvements are themselves large and these costs are very nearly immediate. Second, virtually no benefits from a large-scale project can accrue until that project is completed and open to use. Annulling a project, once design and construction have commenced, usually results in a complete waste of any expended funds. Next, project benefits accrue over the life of the infrastructure and that is generally a long time. Finally, large-scale infrastructure projects can, by their very presence, change the future demographic and economic circumstances that underlie the assessment of future infrastructure benefits. Thus, the “but if” component of forecasting future use and resulting benefits often becomes an important part of the discussion.

In order for a proposed, large-scale transportation infrastructure project to move forward, it must overcome each of these issues in a political environment where increasing demands for public resources compete for available resources.

Population Growth, Global Trade and Other Long-Run Factors

As the preceding section makes clear, it is certainly tempting and sometimes prudent to forego long-lived infrastructure investments when and where it is possible. Nonetheless, incremental transportation capacity improvements are exhaustible. Eventually we will be called on to undertake the difficult forecasts and analyses needed to justify large-scale transportation infrastructure
improvements. Each specific project requires its own unique research design. Still, there are a handful of forward-looking questions that impact the evaluation of nearly every major transportation proposal within the foreseeable future. These questions include –

- Will the demographic trends favoring growing populations in the south and southeastern U.S. continue and, if so, how should Tennessee prepare for sustained population increases?
- When the growth in global commerce as a component within Tennessee’s economy resumes as the world economy recovers from recession, what will increased international trade require of Tennessee’s transportation networks?
- Both in terms of international and domestic freight traffic, how important is intermodal truck-rail transportation and what does its continued growth mean to transportation planners and practitioners in Tennessee?
- Will the confounding volatility in global petroleum prices continue to hamstring our ability to forecast fuel prices and, if so, how will this affect the demand for and ability to fund transportation infrastructures?
- What will be the form and extent of future safety, security, environmental, and community livability standards as they apply to transportation in Tennessee?

Without necessarily offering any answers, the text that follows attempts to more clearly frame these questions.

State and Regional Population Growth

Table 4.10 provides 2010 population estimates and 2030 population forecasts for Tennessee and nine surrounding states. Tennessee’s projected population growth rate is slightly greater than both the weighted 10-state average growth rate and the weighted national growth rate. Moreover, there are similar results for the nearby states located to the east, along the eastern seaboard. However, estimated population growth in Alabama, Arkansas, Kentucky, Mississippi, and Missouri is forecasted to be lower than both the Tennessee value and the weighted regional average. This result should be recalled as the discussion turns toward import growth.

International Trade, Intermodal Transport, and Trade-Related Transport Demands

TDOT’s recently updated Statewide Freight Plan carefully considers international trade growth, the role of trade within the Tennessee economy, and ways in which this trade is likely to affect the demand for transportation facilities over the coming decades. The TDOT analysis makes several relevant points. First, the demand for imported consumer goods is largely population driven.

The relatively strong population growth projected for Tennessee – particularly in its metropolitan areas – therefore suggests that the need to move import shipments into the state will also grow faster than average. The TDOT report also suggests that import freight traffic is particularly important to the Tennessee economy. Overall import volumes
are relatively high, but when these are adjusted to reflect differences in workforce size, Tennessee ranks fifth nationally in the annual value of per-worker imports.

Whether the issue is the import of intermediate goods for Tennessee producers or the import of consumer products necessary to support a growing population, the freight flows that support this import traffic are likely to change within the coming years. In 2014, improvements to the Panama Canal are scheduled to be complete. At that point, the size of the container vessels that can transit the Canal will triple. This, in turn is projected to significantly increase the volume of Asian containers that cross eastern U.S. ports. There is much conjecture regarding which specific ports will see the greatest traffic increases, but there is at least some sense that, for Tennessee-bound traffic, Charleston and Savannah will see the greatest increases. If this speculation is correct, it will measurably increase the freight traffic that enters the state via the Atlanta-Chattanooga gateway. It is also likely that a smaller amount of Tennessee-destined import traffic will enter the U.S. via the Port of Mobile en route to destinations in western Tennessee.

Finally, while population forecasts for Tennessee and its eastern neighbors are stronger than average, the strongest population growth is projected for Texas and other parts of the southwest. Much of the increased freight traffic necessary to service a rapidly growing Texas economy will be to and from the west coast. Also, the Port of Houston, already one of the nation’s busiest container ports, is expected to continue its rapid growth. However, to the extent that traffic to and from Texas is routed over east coast ports, much of this traffic will traverse Tennessee, both by truck and by rail. This possibility, combined with increased freight demands within Tennessee, places particular importance on efforts to develop intermodal facilities and to preserve fluid traffic movements on I-40 between Knoxville and Memphis.

Intermodal freight transportation is a phrase applied to any multi-modal freight combination in which modal identities become

### Table 4.10. Tennessee’s Projected Population Growth Is Strong

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>4,596,330</td>
<td>4,874,243</td>
<td>6.0%</td>
</tr>
<tr>
<td>Arkansas</td>
<td>2,875,039</td>
<td>3,240,208</td>
<td>12.7%</td>
</tr>
<tr>
<td>Georgia</td>
<td>9,589,080</td>
<td>2,017,838</td>
<td>25.3%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>4,265,117</td>
<td>4,554,998</td>
<td>6.8%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>2,971,412</td>
<td>3,092,410</td>
<td>4.1%</td>
</tr>
<tr>
<td>Missouri</td>
<td>5,922,078</td>
<td>6,430,173</td>
<td>8.6%</td>
</tr>
<tr>
<td>North Carolina</td>
<td>9,345,823</td>
<td>2,227,739</td>
<td>30.8%</td>
</tr>
<tr>
<td>South Carolina</td>
<td>4,446,704</td>
<td>5,148,569</td>
<td>15.8%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>6,230,852</td>
<td>7,380,634</td>
<td>18.5%</td>
</tr>
<tr>
<td>Virginia</td>
<td>8,010,245</td>
<td>9,825,019</td>
<td>22.7%</td>
</tr>
<tr>
<td>10-State Tot / Avg.</td>
<td>58,252,680</td>
<td>8,791,831</td>
<td>18.1%</td>
</tr>
<tr>
<td>National Average</td>
<td></td>
<td></td>
<td>17.7%</td>
</tr>
</tbody>
</table>

4.4. Looking Toward the Horizon, continued

less important than the efficient movement of a shipment from its ultimate origin to its final destination. In practical terms, however, those who refer to “intermodal” transport are almost always envisioning truck-rail combinations where the local convenience of motor carriage is combined with the line-haul efficiency of railroads to provide freight services that look and feel like trucking, but are available at a measurably lower unit cost.

Further, it is impossible to discuss intermodal’s history without referencing the growth of global commerce. Global commerce (as we now know it) would not exist without intermodal transportation and, at the same time, it is the need to move goods internationally that has introduced most American businesses to the concept of truck-rail intermodal transport. It is the international movement of goods that lead to huge new private investments in intermodal terminals. And it is trade-related traffic that spawned more than a decade of double-digit intermodal traffic growth in the U.S. Somewhat more recently, American shippers have learned to effectively apply the lessons from international shipping to domestic goods movements. However, it is the link between global markets and intermodal shipping that will be recounted by historians.

**Petroleum Prices**

Without question, the long-run course of petroleum and petroleum product prices is the greatest wildcard facing Tennessee transportation planners and policy-makers. Substantial changes in petroleum prices would affect overall traffic volumes, modal splits, and the cost of building and maintaining infrastructure. Figure 4.3 provides two separate looks at fuel prices. The first panel of this figure tracks the price forecasts proffered by the U.S. Department of Energy’s Energy Information Administration (EIA). The second panel depicts gasoline prices on a weekly basis both before and after the terrorist attacks in 2001.

Current petroleum prices are tracking between the midrange and upper EIA forecast levels. At the same time, it is clear that since 2001, petroleum and petroleum product prices have become much more volatile. The result is a future for petroleum prices that is nearly impossible to forecast with any degree of comfort. Moreover, it is unlikely that alternatively-fueled vehicles will play a significant role in either passenger or freight transportation for at least a generation (20-30 years). Thus, there is no realistic way to shield Tennessee’s population from the potential impacts on both transport demand and supply that would result from an unanticipated disturbance in petroleum prices. The only possible counsel is for policy-makers to never fully discount the seemingly impossible when it comes to future petroleum prices changes and the demands they would place on state government.

**Public Welfare – Safety and Security**

While fuel prices are largely unpredictable, the current trend toward safer, more secure, environmentally- and community-friendly transportation is both observable and likely to continue without change. This pattern certainly reflects a federal, top-down set of priorities. However, it is also echoes the at-home attitudes of most Tennesseans. Mobility is critical, but it cannot be maintained at any cost.

An emphasis on transportation safety is not new; state efforts (and resulting records) date to 1950. However, much as with other transportation topics, state-sponsored safety activities are heavily weighted toward highway transport. Safety efforts fall within three categories – enforcement, facility design and maintenance, and user education. These areas are administered by the Tennessee Department of Safety (TDOS), Department of Transportation (TDOT), and Governor’s Highway Safety Office (GHSO), respectively.

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14 The discussion above describes Tennessee’s participation in the Crescent Corridor initiative. Crescent is one of the first major efforts to extend the benefits of intermodal shipping to a broader range of domestic freight customers by developing a truck-competitive intermodal alternative for domestic shippers in the eastern U.S.
As noted, vehicle safety standards (and to a large degree, enforcement) fall within the jurisdiction of the federal government. Attributing results to specific activities is beyond the scope of the current analysis. However, the sum result of the state-sponsored efforts is a dramatic drop in the rate of fatalities per hundred million Vehicle Miles Traveled. In 2009, this rate for Tennessee motorists, passengers, and pedestrians was only 1.40, or roughly 17 percent of the rate (8.28) recorded in 1950.

From a fiscal standpoint, nearly all funding for infrastructure safety activities has its source in federal pass-through dollars. Federal funding for all programs totals roughly $50 million annually or roughly seven percent of total federal transportation spending within the state. Of this sum, roughly half passes through directly to Tennessee communities for community-initiated programs.

Transportation security is, for the most part, not a state issue. Most transportation-related security efforts are focused on commercial passenger transport or the movement of freight. Moreover, much of the security emphasis in both areas is related to non-highway transport modes where rule-making falls directly under federal jurisdiction. The most visible exception to this pattern is in the area of disaster response. Both community planners and first responders have been encouraged to now prepare for the aftermath of security breaches as well as natural disasters. Tennessee, like most states, has cooperated in these efforts, with much of the necessary coordination coming through state-level authorities.

Public Welfare – the Environment and the Quality of Life

Just as Tennesseans want transportation that is safe and reasonably secure, they also demand increasingly improved environmental outcomes and a system of transportation that blends well with broader community goals.

Environmental standards are imposed through a variety of federal statutes governing air quality, water quality, the protection of fish and wildlife habitat, etc. and there is significant federal enforcement by the US Environmental Protection Administration.
4.4. Looking Toward the Horizon, continued

(EPA). However, state agencies are expected to be vigilant partners in the enforcement process and, in particular, TDOT is expected to comply with all applicable environmental standards and practices in its design and construction of transportation infrastructures – primarily roadways.

Environmental compliance requires resources – both time and money – that were unnecessary when public policy allowed for the relative neglect of environmental outcomes. The exact magnitude of these additional costs varies widely, depending on project scale, scope, and location. Still, FHWA studies on the topic suggest that the overall cost increase attributable to environmental compliance ranges between 10 and 20 percent of project totals. This is true with respect to time and funding. Most of these costs are incurred in the planning and design stage, while the impacts on right-of-way acquisition and project construction are somewhat smaller.

Over the past two generations, planners and policy-makers have come to understand and, as necessary, quantify the basic environmental outcomes related to transportation infrastructure and its use. This has not always been easy and involves processes that are still not completely free of controversy. Thus, it is with some hesitancy that the same analysts are now learning to address an additional set of community concerns. These concerns center on “livability” issues that extend beyond traditional environmental outcomes.

Specifically, while nearly everyone accepts that the development, maintenance, and use of transportation carries realities that impact both community aesthetics and the convenience of daily life, populations are increasingly demanding that these costs be explicitly considered within the transportation process so that they can be minimized, mitigated and, where necessary, justly imposed on varying segments of the population. More than anything else, this has increased the attention to land-use planning. It has also lead to the integration of additional concepts including “context sensitive design,” “environmental equity,” and infrastructure recycling.¹⁵

Infrastructure Costs and Fiscal Realities

For most Tennessee families and businesses, good transportation depends on the ability to build and maintain good roads. A brief sketch of TDOT expenditures during 2007 was presented above, wherein roughly half of all money spent went for new roadway construction and half went toward the maintenance of existing structures. Prior sections also describe current roadway outcomes (quality and performance) within the state that are clearly superior to roads found in many other places. The challenge for Tennessee’s transportation planners and policy-makers is to sustain this relative advantage going-forward.

¹⁵ Context Sensitive Design involves developing infrastructures that detract as little as possible from historic or aesthetic nature of the surrounding community. It also indirectly implies scaling infrastructure so that it does not dominate the local landscape. Environmental Equity is a related concept through which the “negatives” associated with infrastructure development are not disproportionately imposed on those segments of the population who are least prepared to resist them. Both context sensitive design and environmental equity provide incentives to reuse or “recycle” infrastructures where doing so does not preclude the achievement of safety or capacity goals.
4.4. Looking Toward the Horizon, continued

The Nature and Scale of the Challenge

Money for roadway maintenance comes from three essential sources. Roughly one-third of funding flows to the state through federal fuel tax revenues. Two-thirds of the available funds come from the state and are developed though fuel taxes and vehicle registration fees. These fees make up 20 percent of the available state funds. Thus, combined federal and state fuel tax revenues account for roughly two-thirds of the state’s annual roadway budget. Simplified representative figures similar to the values above are provided in Table 4.11.16

Table 4.11. Representative Budget Values

<table>
<thead>
<tr>
<th>Revenues From</th>
<th>Dollars ($billions)</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Funds</td>
<td>1.08</td>
<td>40%</td>
</tr>
<tr>
<td>State Gas</td>
<td>0.73</td>
<td>27%</td>
</tr>
<tr>
<td>Vehicle Registration</td>
<td>0.32</td>
<td>12%</td>
</tr>
<tr>
<td>Other State Fees</td>
<td>0.41</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Total Funds</strong></td>
<td><strong>2.70</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Both the federal and state fuel taxes are levied as excise taxes where the tax base is the number of gallons of fuel purchased rather than a sales type (i.e. ad valorem) tax where revenues are based on the value of the tax base. This distinction has profound implications for roadway funding. Fuel price increases are invariably accompanied by reduced consumption. In the case of a sales-based tax, the implication of a fuel price increase on fuel tax consumption is unclear (prices increase, gallons decrease, revenue impacts are indeterminate). However, when fuel taxes are levied against physical fuel quantities, an increase in fuel prices will cause fuel tax revenues to decline. The same outcome is true with respect to fuel conservation. Any success in reducing fuel consumption will lead to relative declines in fuel-based excise revenues. Thus, two-thirds of the revenue stream depicted above is, at best, vulnerable.

This outcome is exacerbated by the relationship between fuel prices and roadway construction costs. Roads paved with asphalt require large volumes of a petroleum-based product. Similarly, the production of concrete is very energy-intensive. Roadway construction also requires large quantities of stone and sand which require large amounts of fuel to quarry and transport. Finally, roadway construction equipment is fuel-intensive in its use. Thus, any increase in fuel prices that diminishes available revenues, simultaneously leads to measurable increases in roadway construction and maintenance costs.

This confounding set of outcomes is not new to transportation planners and policymakers. It has been the topic of thousands of hours of discussions and, perhaps, ten times as many pages of published research. There are, however, only two meaningful conclusions. First, there is no easy, politically acceptable solution. Second, the ability to remedy the foreseeable highway revenue shortfall through frugality and increased productivity is nearly exhausted.

Choosing Among Difficult Alternatives

The arithmetic is not difficult. In Tennessee’s case, the sum value of the revenue shortfall over the next 25 years is between $10 and $30 billion depending on the level of desired new construction, maintenance costs and changes in fuel consumption. There is no scenario that preserves current levels of mobility with the number of dollars that will be available. Thus, a difficult choice (or combination of choices) will be made by current and future state leadership.

The first choice is to preserve the status quo in terms of revenue development and simply live with the consequence of diminished mobility. In a sense, this alternative is partially self-correcting. The unwelcome increases in congestion, travel times, and safety outcomes will, unquestionably lead to increased fuel consumption and corresponding

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16 The budget values provided in Table 4.7 reflect only annual revenues and expenditures planned from those revenues. The stylized budget values portrayed in Table 4.11 include the Table 4.7 values PLUS budget revenue carry-overs and planned expenditures from previous year budgets.
fuel tax collections. This is, of course, completely counter to nearly every other goal established for the state's transportation policy. It will harm commerce, diminish the quality of community life, and retard environmental efforts.

The second alternative is to look to either the federal government or future generations of Tennesseans for a funding remedy. Readers will recall, however, that federal highway revenues are also derived through fuel excise taxes, so that competition for federal highway funds is also likely to increase. Furthermore, Tennessee has an 80 year history of rejecting bond financing for highway construction, let alone maintenance.

The final alternative to the looming funding shortfall is to revise the revenue instruments used to generate necessary funds. This course is also replete with difficulties. The simplest remedy would be to increase the rates applied under the current system of fuel excise taxes. Eliminating the foreseeable revenue deficits would require an increase of approximately five cents per gallon on both gasoline and diesel fuel for on-road vehicles. Fuel tax rates in Tennessee were last increased in 1977 and have been a routine topic of policy discussion for at least two decades. So far, however, this avenue has not been vigorously pursued.

A second, more radical course, would involve changing the fuel tax base from the currently used purchased quantity to one of two alternatives. The simplest of these would convert the excise tax to a sales-based tax. This would help insulate the fuels-based revenue stream from increased fuel prices, but it would also amplify the pain suffered by Tennessee motor fuel users under such price increases.

An even more radical course involves substituting vehicle miles traveled as the base for fuel taxes. This has the advantage of automatically dampening the revenue impacts of fuel conservation. However, in some sense, it also diminishes the rewards to individual conservation efforts and, perhaps, more importantly, a VMT-based fuel tax would be significantly more difficult to collect.

Policy and Planning Notes

The “pay-as-you-go” strategy which largely limits bonded debt as a means of financing transportation infrastructure before the needed cash is in hand is a policy deeply rooted in the state's decision-making culture.

If planners can adequately anticipate future transportation needs and corresponding strategies and if policy-makers make decisions based on that information, “pay-as-you-go” unnecessarily slows the state’s response to foreseeable change, thereby measurably inconveniencing users and hampering commerce. Alternatively, “pay-as-you-go” may protect the state from ill-advised debt in situations where planning is incomplete, political considerations weigh heavily in decision-making, or circumstances are too volatile for long-term investment decisions.

A middle course might make bonded funding more readily available, but only in situations where a strictly determined set of planning criteria have been satisfied. However, even this relatively moderate course may be difficult to achieve given the topic's political history.
4.5. Concluding Thoughts

Each generation takes in hand what it is given, looks as well into the future as possible and acts with all the resources and imagination it has to make it easier to move people and freight where they need to go. It is fortunate that the world of transportation planning is very forgiving. Those mistakes that cannot be readily concealed are usually quickly forgotten.

Conclusions based on the information contained herein include –

• Tennessee begins with robust passenger and freight transportation networks that span modes and make global access as easy and efficient as they are for any location in the interior U.S.;
• Tennessee’s economy – particularly in metropolitan areas and particularly in relation to imported intermediate goods – is dependent on continued, affordable mobility and global connectivity;
• The dichotomy between rural and metropolitan needs is substantial. There is, however, no evidence suggesting that transportation resources in rural communities are particularly lacking or that additional investments in rural transportation infrastructure will result in measurable new prosperity;
• Currently observable trends regarding population growth and the growth of international commerce will continue to place new demands on transportation resources within the state;
• Tennessee cannot be made immune to the vast uncertainties that owe to volatile fuel availability, pricing, and use;
• Tennessee’s reliance on a “pay-as-you-go” system of finance and leanings toward relative local autonomy have left it better positioned than states that have relied more heavily on bonded debt and adopted a more centralized transportation planning role; and
• The fiscal verities that face all states (and the nation as a whole) are no less real in Tennessee. The issue of adequate financing will not be avoided for another generation.

There is no pending calamity, no need for urgent reform. There is simply very important work to be continued and vigilance to be maintained. There are more needs and wants than resources will afford and difficult choices to be made. Certainly, however, this circumstance does not distinguish transportation planning and policy from other areas of concern within the state. To the contrary, the leadership exerted over transportation decision-making has helped to ensure that transportation is not an arena in which the state is lacking or where Herculean reforms are required.

Policy and Planning Notes

Regardless of the transportation topic, fuel prices, availability, and usage seem to be the 800 pound gorilla in every room. Unforeseeable changes in fuel prices, particularly if they are sustained, can radically alter demands for both passenger and freight transportation, affect vehicle designs and usage, alter household migration and, confer or diminish individual, regional, and even national wealth on a large scale.

Within the current discussion, fuel prices and usage patterns simply confound the ability to plan and finance roadway construction and maintenance. A simple (and almost never-discussed) alternative would be to abandon fuel-based taxes as a form of highway financing in favor of a more general, more stable revenue source. It is, however, difficult to imagine the discussions that would surround any such proposal.