Standard Title Page — Report on State Project

Report No.	Report Date	No. Pages	Type Report:		Project No. :
VTRC 93-TAR5	May 1993	62	Technical Assistance Report		93–98–033–940
			Period Covered:		Contract No. :

Title and Subtitle	Key Words
The Geographic Distribution of HMOF and TTF Revenues and Allocations in Virginia From FY 88 Through FY 92	transportation finance geographic distribution

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Supplementary Notes

None

Abstract

This paper describes the current structure of transportation finance in the Common-wealth. The financial structure is made up of estimated revenues and recommended allocations. We present comparisons of the shares of state and federal transportation revenues and allocations for each of the nine VDOT construction districts. The analysis includes all state and federal funds that flow through both the Highway Maintenance and Operating Fund (HMOF) and the Transportation Trust Fund (TTF). We present the estimates in three parts. In the first section, we examine the geographic distribution of transportation allocations for each of VDOT's four primary activities: construction, maintenance, nonhighway modes (mass transit, ports, and airports), and administration and overhead as well as for the aggregate transportation program. In the second section, we estimate the geographic distribution of transportation revenues for the four primary activities listed above and the aggregate program. Finally, for the same activities and the aggregate, we present the ratio of the share of total allocations to the share of total revenues for each construction district.

THE GEOGRAPHIC DISTRIBUTION OF HMOF AND TTF REVENUES AND ALLOCATIONS IN VIRGINIA FROM FY 88 THROUGH FY 92

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(The opinions, findings, and conclusions expressed in this
report are those of the authors and not necessarily
those of the sponsoring agencies.)

ABSTRACT

This paper describes the current structure of transportation finance in the Commonwealth. The financial structure is made up of estimated revenues and recommended allocations. We present comparisons of the shares of state and federal transportation revenues and allocations for each of the nine VDOT construction districts. The analysis includes all state and federal funds that flow through both the Highway Maintenance and Operating Fund (HMOF) and the Transportation Trust Fund (TTF). We present the estimates in three parts. In the first section, we examine the geographic distribution of transportation allocations for each of VDOT's four primary activities: construction, maintenance, nonhighway modes (mass transit, ports, and airports), and administration and overhead as well as for the aggregate transportation program. In the second section, we estimate the geographic distribution of transportation revenues for the four primary activities listed above and the aggregate program. Finally, for the same activities and the aggregate, we present the ratio of the share of total allocations to the share of total revenues for each construction district.

EXECUTIVE SUMMARY

The growing gap between transportation needs and revenues has led to heightened concern about the equity of the distribution of revenues and allocations in Virginia. This report presents estimates of the distribution of transportation allocations and revenues to the nine VDOT construction districts from FY 88 through FY 92.

Allocation to Revenue Ratios - The District "Return"

The following table presents the average ratio of allocation to revenue shares over the period FY 88 through FY 92.

Ratio of Allocation to Revenue Shares
by Construction District
Average FY 88-FY 92

District	Allocation/Revenue Ratio
Bristol	1.35
Culpeper	0.92
Fredericksburg	0.93
Lynchburg	1.03
Northern Virginia	0.95
Richmond	0.84
Salem	0.89
Staunton	0.88
Suffolk	1.20

The ratios can be interpreted as the return on each dollar of transportation revenues raised in that district. In other words, a 5-year average ratio of 1.35 in Bristol can be viewed as a return of approximately $1.35 for each dollar Bristol deposited in the HMOF and the TTF over the 5-year period. Similarly, an average 5-year ratio of 0.88 in Staunton represents a return of approximately 88 cents for each dollar contributed by the district over the period.

Several points are apparent when examining the 5-year average ratios:

* With three exceptions, each VDOT construction district receives *approximately* a dollar for dollar return for the entire transportation program, *on average*, from FY 88 through FY 92. In Culpeper, Fredericksburg, Lynchburg, Northern Virginia, Salem, and Staunton, the ratios are within a reasonable range of a ratio of 1.0.

- Those districts with 5-year average ratios substantially greater than 1.0 (Bristol and Suffolk) are net recipients of transportation funds.

- Richmond, the only district with a 5-year average ratio significantly less than 1.0, is a net donor of transportation funds.

VDOT Activity Analysis

VDOT's major activities can be classified into four categories: construction, maintenance, nonhighway (public transportation, rail, airports, and ports), and administration/overhead. Construction and maintenance receive the highest allocations, accounting for, on average, 49 percent and 37 percent respectively of the yearly VDOT budget.

Examining the revenue to allocation ratios for each activity, it is clear that dollar return for each of the activities is often very different within a particular district from the dollar return for the overall program. In particular, the following observations may be made:

- The more rural districts, on average, are net recipients for maintenance and net donors for construction.

- The more urban districts receive larger returns for construction than for maintenance. In addition, the urban districts of Northern Virginia and Suffolk are net recipients for the nonhighway activity.

Annual Variations

The dollar returns to each of the major activities as well as to the entire program vary over the 5-year study period. Although revenues remain relatively stable, allocations to districts tend to drive the variation in the dollar returns. An examination of the yearly dollar returns yields the following observations:

- The allocation of the interstate construction program is the primary factor underlying changes in the allocation to revenue ratios.

- A change in a district's dollar return to any one activity is likely to be different from the change in the district's overall dollar return. For example, Suffolk's construction return fell by 0.43 from FY 91 to FY 92 (from 1.39 to 0.96), but its overall dollar return only fell by 0.19 (from 1.21 to 1.02).

Recommendation

This report has shown that any alteration in the Commonwealth of Virginia's transportation allocation process that results in significant changes for districts' returns to a particular *activity* will have a much smaller impact on the *overall* return. For this reason, any proposed modification to the definition of equity for particular categories of activities must be analyzed in the context of the impact on the balance of the system.

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INTRODUCTION

Virginians and travelers who use the roads in Virginia are assessed a number of taxes and user fees to support the state's transportation system. As with any public service, it is the Commonwealth's responsibility to ensure that these taxes and fees are used equitably and productively to maintain, operate, and enhance the transportation network. The taxpayers and feepayers expect to receive a fair return in terms of mobility for the dollars they contribute to the system.

Concerns about receiving fair returns have intensified in recent years in large part because of the "infrastructure crisis." In Virginia, real transportation needs have grown faster than available resources. In fact, available resources have decreased in recent years. Figure 1 shows that the total transportation program peaked in real dollars in FY 89 and has leveled off since FY 90. The noninterstate construction program began to shrink in FY 88. This growing gap between real needs and available resources merits an examination of the Virginia Department of Transportation's (VDOT) use of scarce resources. An important component of such an examination consists of analyzing the geographic distribution of transportation revenues and allocations.

Such an examination of the distribution of funds brings into question the concept of equity. Acceptable definitions of equity vary considerably. One definition of equity would ensure that revenues generated are matched dollar for dollar by allocations to a particular geographic region. Equity could also be defined to ensure that only direct users of the transportation system pay for the network of roads and bridges constructed and maintained in the Commonwealth through a comprehensive system of user fees. Another definition of equity could be based on needs; for example, funds could be distributed to deal with the most pressing transportation needs first regardless of where they were located; thus regions would take turns helping each other build expensive projects.

Billions of FY 1991 Dollars
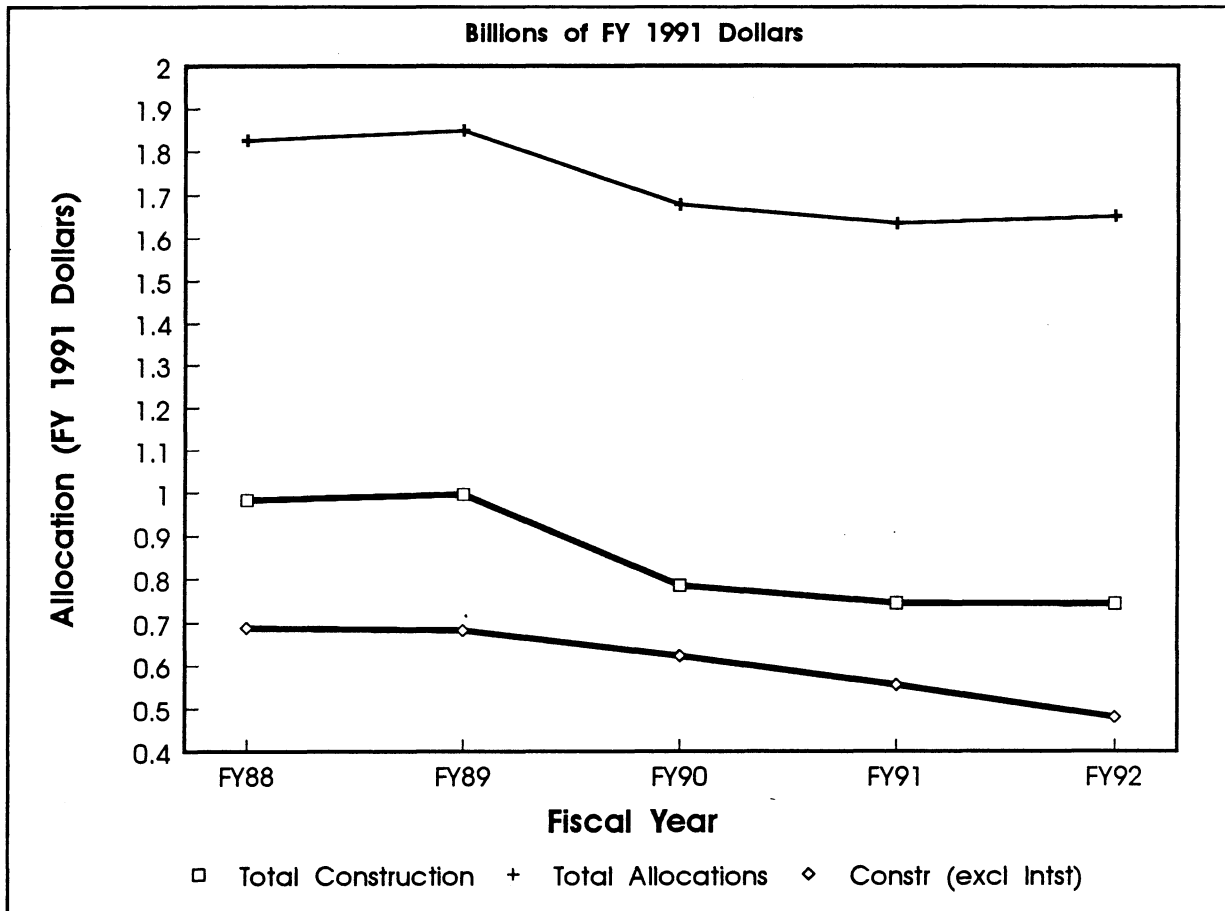
Figure 1. Trends in transportation resources.

Source: Derived from VDOT's *Budget* using national index for state and local goods (*Economic Indicators*). Resources include HMOF and TTF, excluding "pass-through" funds (i.e., tolls, coal severance tax, Rt. 28 Special Assessment District Resources).

Clearly, there are a number of feasible definitions of equity. Unfortunately, there are many factors which make a universally accepted definition of equity impossible to achieve. For example, the complexity of providing a "safe, efficient, effective, and environmentally-balanced surface transportation system" as mandated by the Department's mission statement (see Appendix A) makes it extremely difficult to precisely measure the true costs and true benefits of transportation services. This complexity is obvious when attempting to define one dollar's worth of transportation service in terms of mobility. Is it one trip on a municipal bus system? Is it a portion of the construction of a new highway facility? Is it one filled pothole? Certainly, there are many activities that make up the provision of a "balanced" transportation system. In fact, some citizens of the Commonwealth may never utilize particular transportation services *directly* but are likely to be indirect beneficiaries of an efficient transportation system through enhanced economic development. In that way, each transportation service plays an important

role in VDOT's mission of providing an effective transportation system that facilitates and promotes mobility and economic activity. Furthermore, the geographic distribution of benefits of the transportation system is not necessarily the same as the geographic distribution of allocations. The true net benefits of transportation improvements in any one region depend in large part on the exact type of infrastructure investment. For example, enhancements to the interstate system that pass *through* a region are sure to generate the largest economic benefits in the neighboring regions with interchanges. Alternatively, the same dollar investment in *local* road construction or maintenance will net the largest return to the region itself. Similar examples could be cited in the context of public transportation and other nonhighway modes. Finally, most definitions of equity are difficult to achieve in a practical sense. For example, transportation allocations and revenues are not handled in such a manner that it is easy to pinpoint the geographic region to which they can be attributed. Another view of equity, the use of direct user fees, would require the extensive use of tolls. Not only would this require a substantial capital investment, but it may also be a very unpopular move in a political sense.

Therefore, the definition of equity for transportation construction funding is dictated by policy and political decisions. In Virginia, a 1984 study of transportation funding conducted by the Joint Legislative Audit Review Committee (JLARC) concluded "that the equity of construction allocations ... [would be] addressed in terms of highway construction needs. That is, ... an equitable distribution of construction funds occurs when the relative proportion of funds allocated to a locality is equivalent to the relative proportion of construction needs in the locality." The Virginia General Assembly adopted this definition by instating construction allocation formulae developed by JLARC that attempt to match transportation need shares.

In 1991, Senate Joint Resolution 188 (SJR-188) mandated that VDOT reexamine the allocation formulae. This resolution was inspired by changing demographics, a new 20-year needs assessment, and a then anticipated new federal-aid program (the 1991 Intermodal Surface Transportation Efficiency Act). The SJR-188 study is based on the same premise as the 1984 JLARC study: that equity is achieved by balancing allocations with needs. However, the SJR-188 study also examined trends in transportation finance within the Commonwealth, thereby allowing for the consideration of equity in a broader context. Central to this analysis of trends was a thorough examination of the geographic distribution of transportation revenues and allocations in Virginia.

Two previous estimates of the dollar returns to transportation revenues have been published. Both of these were limited to the Northern Virginia District. In 1989, KPMG Peat Marwick conducted "A Study of Financial Resources for Transportation in Northern Virginia" for the Northern Virginia Transportation Commission. They estimated that the Northern Virginia construction district received 63.2 percent of each state transportation dollar generated in the region in FY 88. The estimate for combined state and federal sources was 71.9 percent in the same year. In 1991, the Senate Finance Committee presented an estimate for Northern Virginia by extending the KPMG Peat Marwick analysis to FY 92. They determined that Northern Virginia was slated to receive 103 percent of each state and federal transportation dollar

generated in the region. The Finance Committee considered the use of combined state and federal funds and allocations to be the most appropriate basis for analysis.

This study represents the most thorough examination of the geographic distribution of transportation allocations and revenues in Virginia to date. The analysis covers a five-year period from FY 88 through FY 92. In addition, it covers the entire Commonwealth of Virginia (breaking the state into nine geographic regions). Finally, the data and models utilized in this study are considerably more comprehensive and complex than those used in previous work. Given these features, this study of the geographic distribution of transportation allocations and revenues provides valuable insight into transportation finance in the Commonwealth.

PURPOSE AND SCOPE

This paper presents estimates of the dollar returns in terms of allocations to transportation revenues raised in each VDOT construction district (see Figure 2). The goal of this paper is not to attempt to define equity. Instead, the analysis is a useful framework in which to consider the potential impacts of changes to the statutory formulae that distribute primary, secondary, and urban construction funds throughout the Commonwealth as called for by SJR-188.

For each of VDOT's nine construction districts, this paper examines all sources of state and federal revenues and allocations that flow through both the Highway Maintenance and Operating Fund (HMOF) and the Transportation Trust Fund (TTF), excluding "pass-through" funds.[1] We present data for the five most recent fiscal years (1988 through 1992) in addition to a five-year average. The average is more representative of the underlying structure of transportation finance in Virginia than any one year since it minimizes the impact of yearly programming decisions and budget fluctuations on the results. Furthermore, the long planning horizon characteristic of large construction projects and maintenance programming introduces a lag in the identification, planning, and budgeting of transportation projects, which should be minimized somewhat by the use of the average figure.

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[1]Funds that "pass through" the budget without any potential for redistribution are excluded from this analysis. These funds include toll facilities funds and coal severance taxes. In addition, only the annual debt service portion of bond sales is included in the allocation to each district since VDOT's annual liability is limited to this amount.

Figure 2. VDOT construction districts.

METHODOLOGY

The estimated geographic distribution of transportation allocations and revenues that flow through the HMOF and TTF are based on VDOT's annual *Budgets*. In addition, the primary VDOT activities are identified based on the general allocation process. A full, detailed description of the methodology used in this research is given in Appendix B and Appendix C of this report.

The district shares of recommended allocations are derived from the VDOT *Budget Supplement* for all five years. The shares are for the *combined* state and federal programs and include allocations from both the HMOF and the TTF. With two adjustments, approximately 90 percent of total HMOF and TTF funds are allocated to VDOT's nine construction districts in a table titled "Distribution of Allocated Revenues by Location" on the last page of each *Supplement*. The remaining 10 percent is classified as either "Central Office" or "Statewide/Other." Appendix B presents the methodology and estimation procedures we developed to distribute these two categories of expenditures to each of the nine districts.

The methodology developed to attribute each revenue source geographically is also detailed in Appendix B. These different sources of revenue include, for example, motor fuels taxes, motor vehicle sales and use taxes, registration fees, and the state sales and use tax. The *Code of Virginia* specifies the distribution of each revenue source to the two transportation funds. For example, the HMOF is made up of approximately 70 percent fuel taxes and Federal aid, whereas the TTF is comprised of approximately 60 percent retail taxes and a transfer from the HMOF.

As noted in Appendix B, this analysis refines and enhances the methodology and models used in the previous work, thereby leading to notably different empirical results. In addition to expanding the scope of previous work to include estimates of the dollar returns to each of Virginia's nine construction districts, this study also presents the returns to each of VDOT's four primary activities--construction, maintenance, nonhighway (mass transit, ports, and airports), and administration/overhead--under which we have classified each VDOT program. The methodology used to define the revenues supporting each activity is described in Appendix C.

RESULTS AND DISCUSSION

Programmatic Distribution

Our examination of the transportation budget revealed programmatic emphases in four different primary activities. The diverse characteristics of these activities led us to examine whether the dollar returns to each of these activities were similar to the dollar return to the entire transportation program for each district. In order to estimate these returns, we classified each transportation program identified in the budget under one of four primary activities:

6

- administrative functions
  - -- administration and supervision
  - -- computer services
  - -- physical plant pervices
  - -- highway vehicle regulation
  - -- ground transportation system planning and research
  - -- highway planning and research & financial assistance for transportation planning
  - -- regulation of outdoor advertising
  - -- support to other state agencies
  - -- trust fund management
  - -- general fund transfer

- construction
  - -- access roads and other construction
  - -- interstate construction
  - -- primary construction
  - -- secondary construction
  - -- urban construction
  - -- construction management
  - -- designated highway corridor development program (Rte. 58)
  - -- toll facilities revolving account
  - -- capital outlay

- maintenance
  - -- interstate maintenance
  - -- primary maintenance
  - -- secondary maintenance
  - -- ground transportation safety research and analysis
  - -- financial assistance to localities for city street maintenance
  - -- financial assistance to localities for county road maintenance

- nonhighway modes
  - -- mass transit assistance
  - -- other transportation modes.

Figure 3 shows the average share of the transportation budget for each of the four major activities. Transportation resources are concentrated on building and maintaining the extensive transportation network in the Commonwealth: well over 90 percent of transportation funding is dedicated to the provision of transportation services, leaving only about 8 percent to be consumed by administration and overhead. However, it should be noted that neither maintenance nor construction dominates the entire transportation program of the Commonwealth.
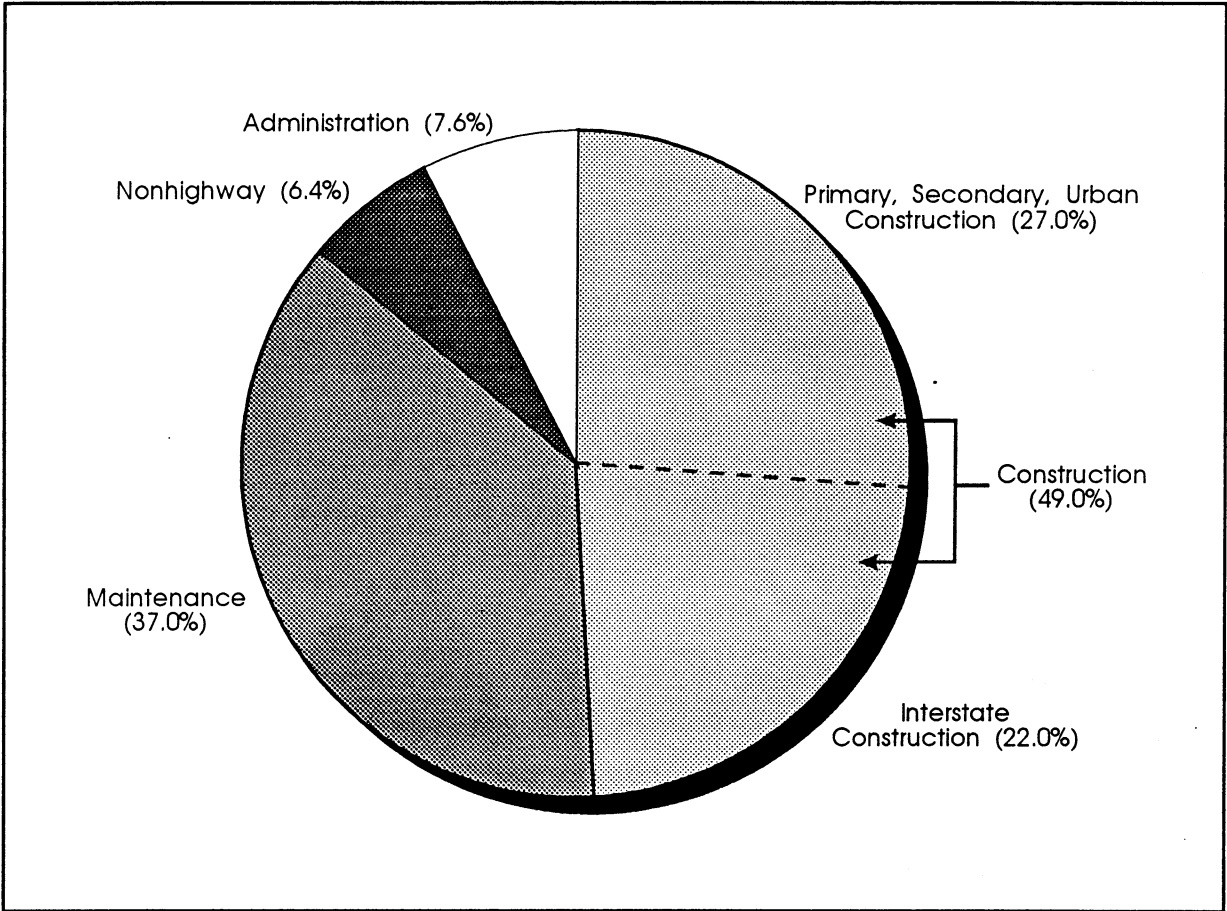
Figure 3. VDOT activities.

Source: VDOT Budgets, FY 88-FY 92.

Geographic Distribution of Transportation Allocations

Table 1 shows that total allocation shares range from roughly 5 percent on average in the Culpeper District to approximately 24 percent in the Suffolk District over the 5-year analysis period. The table also shows the allocation to each of the four major activities for each district. These estimates indicate the relative priority of each program within each district during this time period. For example, maintenance is the focus of the transportation program in the more rural districts, and construction is the dominant activity in the urban areas. In four relatively rural districts (Bristol, Lynchburg, Salem, and Staunton) the maintenance allocations shares are more than 2 percentage points larger than the construction allocations shares (in Culpeper the maintenance share is almost 2 percentage points larger than the construction share). Alternatively, in the more urbanized Northern Virginia and Suffolk districts, the construction shares are more than 5 percentage points greater than the maintenance shares. In Fredericksburg and Richmond, the activities are given almost equal priority on average.

Taken alone, however, these allocations shares do not provide much information about whether the transportation program is distributed geographically according to any rational plan. The *Code* provides guidance in evaluating the distribution by stating that transportation construction funds are to be allocated according to 20-year construction needs for each highway system. One general statistical test of whether the allocation process adheres to this criterion is the correlation between the estimated 5-year average construction allocations shares for all four highway systems (interstate, primary, secondary, and urban) and the 20-year construction needs shares for the same four systems. The strong and significant correlation coefficient (R = 0.95) provides preliminary evidence[2] that the aggregate allocations are consistent with the planning process undertaken by VDOT and community planners to identify the 20-year transportation construction needs. Note, however, that this statistic does not evaluate the extent to which the allocations shares match the needs shares for each individual highway system.

The table also shows that, in general, changes in the construction allocation are the primary cause of changes in each district's share of the total transportation allocation. Furthermore, note that for each district, the magnitude of the percentage point change in the construction allocation share is roughly twice the corresponding percentage point change in the entire transportation program.

- Allocation shares for all activities and for construction remain relatively stable over the 5-year period in six districts: Bristol, Culpeper, Fredericksburg, Lynchburg, Salem, and Staunton (the decline is roughly one percentage point or less from FY 88 to FY 92.)

- In the Richmond and Suffolk districts, allocations shares fell by more than two percentage points from FY 88 to FY 92. Reductions in interstate construction allocations are largely responsible for this decline.

- In Northern Virginia, the total allocation share grows from 17.3 percent in FY 88 to 27.3 percent in FY 92. The construction allocation share grows by roughly twice this amount (from 14.6 percent to 35 percent) over the same time period. This is primarily the result of the addition of two large interstate construction projects (HOV lanes for I-66 and I-95) in the district.

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[2]SJR 188 is designed to explore this issue in depth for the different transportation modes and for each highway system.

Table 1
Allocation Shares by Construction District FY 88-FY 92 (Percentage of Total)

	FY 88	FY 89	FY 90	FY 91	FY 92	5-yr avg.
Bristol						
All Activities	**9.1**	**8.6**	**9.4**	**9.5**	**8.8**	**9.1**
Construction	8.7	8.0	9.6	9.2	7.9	8.7
Maintenance	11.3	10.8	10.6	11.3	11.2	11.0
Administration	8.9	9.2	9.3	9.0	8.5	8.9
Nonhighway	1.4	1.7	1.9	1.8	2.0	1.8
Culpeper						
All Activities	**5.2**	**4.7**	**5.2**	**5.0**	**5.0**	**5.0**
Construction	4.3	4.1	5.0	4.5	3.9	4.4
Maintenance	7.1	5.8	5.7	5.7	6.6	6.2
Administration	6.1	6.2	6.7	6.6	6.4	6.4
Nonhighway	1.6	2.0	2.0	2.0	2.2	2.0
Fredericksburg						
All Activities	**6.1**	**5.2**	**5.8**	**5.3**	**4.9**	**5.5**
Construction	6.7	5.2	6.5	5.1	4.5	5.6
Maintenance	5.8	5.8	5.5	5.9	5.6	5.7
Administration	6.6	6.4	6.7	6.4	6.3	6.5
Nonhighway	1.3	1.4	1.6	1.4	1.6	1.4
Lynchburg						
All Activities	**6.5**	**6.4**	**6.9**	**6.6**	**6.4**	**6.6**
Construction	5.9	5.7	6.5	6.0	5.4	5.9
Maintenance	7.9	8.0	7.8	7.8	7.8	7.9
Administration	8.0	8.0	8.5	7.7	7.7	8.0
Nonhighway	2.4	2.1	2.5	2.3	2.3	2.3
Northern Virginia						
All Activities	**17.3**	**17.3**	**18.4**	**20.1**	**27.3**	**20.1**
Construction	14.6	14.5	16.4	20.5	35.3	20.3
Maintenance	13.7	14.7	14.9	14.6	14.8	14.5
Administration	20.2	20.0	18.7	19.2	20.2	19.7
Nonhighway	56.4	54.2	52.3	52.3	52.5	53.5
Richmond						
All Activities	**14.1**	**15.0**	**13.3**	**13.2**	**12.0**	**13.5**
Construction	15.3	16.8	13.1	12.6	10.5	13.6
Maintenance	13.7	13.9	14.3	14.7	14.0	14.1
Administration	14.7	14.5	14.7	15.0	14.7	14.7
Nonhighway	6.3	6.4	6.7	7.2	7.2	6.8
Salem						
All Activities	**9.3**	**9.1**	**9.6**	**9.3**	**8.7**	**9.2**
Construction	8.7	8.6	9.4	8.6	7.8	8.6
Maintenance	11.5	10.9	10.9	11.0	10.4	11.0
Administration	9.9	10.1	10.3	10.0	10.0	10.1
Nonhighway	2.3	3.0	2.6	2.7	2.6	2.6
Staunton						
All Activities	**7.3**	**7.2**	**7.8**	**7.3**	**6.8**	**7.3**
Construction	6.4	6.1	6.8	6.1	5.5	6.2
Maintenance	9.9	9.8	10.0	9.3	9.0	9.6
Administration	7.6	8.4	8.1	7.8	7.6	7.9
Nonhighway	1.4	1.6	1.8	1.6	1.8	1.6
Suffolk						
All Activities	**25.1**	**26.3**	**23.7**	**23.7**	**20.1**	**23.8**
Construction	29.4	31.0	26.8	27.5	19.2	26.8
Maintenance	19.2	20.2	20.4	19.7	20.6	20.0
Administration	18.0	17.3	17.0	18.3	18.5	17.9
Nonhighway	27.0	27.8	28.5	28.6	27.9	28.0

Figure 4 presents trends in interstate construction allocation shares for all nine districts beginning in FY 83 to illustrate the flexibility in interstate construction allocations. Several trends are apparent in the data for the entire graph, although the discussion that follows will be limited to the FY 88-FY 92 period. Table 2 presents construction and interstate construction allocation shares for the period. First, note that the interstate construction program in five districts--Bristol, Culpeper, Lynchburg, Salem, and Staunton-- has remained relatively small and stable over the period. Second, note that interstate allocations were concentrated in the Richmond and Suffolk districts in the first two years of this analysis. The interstate allocation share dropped off considerably in the Richmond District (from 24 percent in FY 89 to 9 percent in FY 90) upon completion of several large projects and continued to shrink to 3 percent in FY 92. Likewise, at the beginning of the 5-year analysis period, Suffolk received relatively large interstate allocations. This funding allowed for the completion of transportation facilities that required several years of concentrated funding (for example, the newly opened Monitor-Merrimac Memorial Bridge-Tunnel). In Suffolk, the share peaked at 56 percent in FY 89 and fell to 21 percent in FY 92. Similarly, in Fredericksburg the share fell from 9 percent in FY 88 to 1 percent in FY 92. With the completion of projects in these districts, the Commonwealth Transportation Board (CTB) directed interstate funding to the Northern Virginia District, as evidenced by the rapid growth in Northern Virginia's interstate construction allocation share from 12 percent in FY 89 to 69 percent in FY 92.
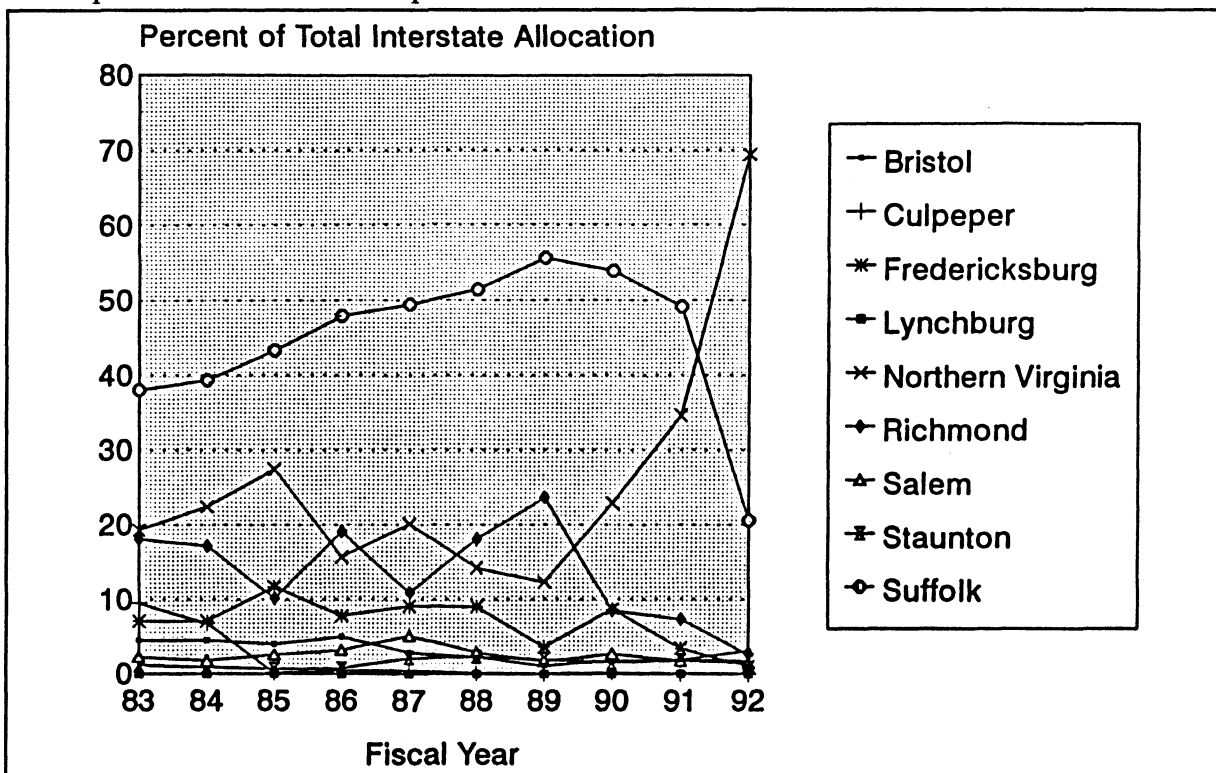

Figure 4. Interstate construction allocation shares.

This illustrates that a primary source of funding flexibility appears to be in the interstate construction program. The flexibility of interstate programming allows the CTB to concentrate funds temporarily in districts that are constructing large, expensive interstate projects. There are potential benefits to this flexibility. One, for example, could be the expediency with which projects are completed. If, for example, each district's interstate construction allocation share were relatively constant (as in the primary, secondary, and urban systems), the accumulation of allocations required to start construction[3] would likely cause delays. Delays, in turn, could increase project costs.

Although there is flexibility in interstate allocations, this is not the case for other highway systems. Table 2 shows that shifts in the interstate construction shares are the primary source of variations in the total construction allocations shares. The construction shares, excluding interstate, are relatively constant (changing less than one percentage point) in seven of the nine construction districts over the 5-year analysis period. In the Northern Virginia and Suffolk Districts, the shares change by less than two percentage points, much less than the corresponding changes in the total construction allocations shares. As mentioned previously, changes in the construction allocations shares are the primary factor underlying changes in the aggregate allocations shares. Thus, our analysis demonstrates that changes in interstate construction shares are the primary cause of changes in aggregate allocations shares.

Geographic Distribution of Transportation Revenues

Table 3 presents the distribution of transportation revenues collected from each district over the 5-year study period for each primary activity and the aggregate program. The data show that the percentage of revenues contributed by each transportation district to the total program and to each of the primary activities remains relatively constant over the entire period. The revenue shares range from approximately 6 percent each for the Culpeper, Fredericksburg, and Lynchburg Districts to approximately 20 percent each for the Northern Virginia and Suffolk Districts. Unlike the allocations shares, the revenue share for each activity is roughly the same as the district's aggregate revenue share. The slight differences occur because similar revenues fund each activity, with the only difference being the exact combination or "mix" of revenues. As a result, each district's revenue contribution to any particular activity differs from its overall contribution to all activities. In FY 88, for example, the Bristol District's overall contribution was 6.7 percent, whereas its share of maintenance was 7.2 percent. These revenue shares are used in the next section to determine the allocations to revenues ratio for each district and for the four primary activities within each district.

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[3]The Department requires the accumulation of 70 percent of the funds required for each phase of construction (preliminary engineering, right-of-way acquisition, and construction) prior to commencement. Resident engineers claim that this requirement often delays project start up and has the potential to increase project costs.

Table 2
Allocation Shares, Construction Activity + Components, FY 88-FY 92 (Percentage of Total)

	FY 88	FY 89	FY 90	FY 91	FY 92
Bristol					
All Activities	**9.1**	**8.6**	**9.4**	**9.5**	**8.8**
Construction Activity	8.7	8.0	9.6	9.2	7.9
Interstate Construction	2.2	1.1	1.8	1.9	3.1
Constr. excluding Interstate	11.4	11.1	11.6	11.6	10.6
Culpeper					
All Activities	**5.2**	**4.7**	**5.2**	**5.0**	**5.0**
Construction Activity	4.3	4.1	5.0	4.5	3.9
Interstate Construction	0.1	0.0	0.2	0.0	0.0
Constr. excluding Interstate	6.2	6.0	6.3	6.0	6.0
Fredericksburg					
All Activities	**6.1**	**5.2**	**5.8**	**5.3**	**4.9**
Construction Activity	6.7	5.2	6.5	5.1	4.5
Interstate Construction	9.0	3.6	8.7	3.4	1.0
Constr. excluding Interstate	5.8	6.0	5.9	5.7	6.4
Lynchburg					
All Activities	**6.5**	**6.4**	**6.9**	**6.6**	**6.4**
Construction Activity	5.9	5.7	6.5	6.0	5.4
Interstate Construction	0.0	0.0	0.0	0.0	0.0
Constr. excluding Interstate	8.5	8.4	8.2	8.0	8.4
Northern Virginia					
All Activities	**17.3**	**17.3**	**18.4**	**20.1**	**27.3**
Construction Activity	14.6	14.5	16.4	20.5	35.3
Interstate Construction	14.2	12.3	22.9	34.6	69.4
Constr. excluding Interstate	14.8	15.5	14.7	15.7	16.6
Richmond					
All Activities	**14.1**	**15.0**	**13.3**	**13.2**	**12.0**
Construction Activity	15.3	16.8	13.1	12.6	10.5
Interstate Construction	18.1	23.6	8.5	7.3	2.6
Constr. excluding Interstate	14.1	13.6	14.3	14.3	14.8
Salem					
All Activities	**9.3**	**9.1**	**9.6**	**9.3**	**8.7**
Construction Activity	8.7	8.6	9.4	8.6	7.8
Interstate Construction	2.9	1.7	2.7	1.8	1.4
Constr. excluding Interstate	11.2	11.8	11.1	10.9	11.3
Staunton					
All Activities	**7.3**	**7.2**	**7.8**	**7.3**	**6.8**
Construction Activity	6.4	6.1	6.8	6.1	5.5
Interstate Construction	2.3	2.0	1.5	1.8	1.8
Constr. excluding Interstate	8.1	8.0	8.2	7.6	7.5
Suffolk					
All Activities	**25.1**	**26.3**	**23.7**	**23.7**	**20.1**
Construction Activity	29.4	31.0	26.8	27.5	19.2
Interstate Construction	51.4	55.6	53.9	49.1	20.6
Constr. excluding Interstate	20.1	19.6	19.7	20.1	18.4

Table 3
Revenue Shares by Construction District, FY 88-FY 92 (Percentage of Total)

	FY 88	FY 89	FY 90	FY 91	FY 92	5-yr Avg.
Bristol						
All Activities	**6.7**	**6.8**	**6.7**	**6.8**	**6.8**	**6.8**
Maint / Admin.	7.2	7.3	7.3	7.4	7.4	7.3
Construction	6.4	6.5	6.3	6.4	6.3	6.4
Nonhighway	6.2	6.0	6.0	6.0	6.0	6.0
Culpeper						
All Activities	**5.4**	**5.5**	**5.5**	**5.5**	**5.5**	**5.5**
Maint / Admin.	5.6	5.8	5.8	5.9	5.9	5.8
Construction	5.2	5.3	5.2	5.3	5.2	5.2
Nonhighway	5.1	5.0	5.0	5.0	5.0	5.0
Fredericksburg						
All Activities	**5.7**	**5.9**	**5.9**	**6.0**	**6.0**	**5.9**
Maint / Admin.	6.1	6.3	6.3	6.4	6.5	6.3
Construction	5.5	5.7	5.6	5.6	5.6	5.6
Nonhighway	5.4	5.3	5.3	5.4	5.4	5.4
Lynchburg						
All Activities	**6.4**	**6.4**	**6.3**	**6.3**	**6.3**	**6.3**
Maint / Admin.	6.7	6.8	6.7	6.7	6.8	6.7
Construction	6.2	6.2	6.0	6.0	6.0	6.1
Nonhighway	6.1	5.9	5.8	5.8	5.8	5.9
Northern Virginia						
All Activities	**20.9**	**20.9**	**21.4**	**21.3**	**21.3**	**21.2**
Maint / Admin.	19.1	19.0	19.3	18.9	18.9	19.0
Construction	22.0	21.9	23.0	22.9	23.0	22.6
Nonhighway	22.6	23.6	24.2	24.3	24.4	23.8
Richmond						
All Activities	**16.2**	**16.1**	**16.0**	**16.0**	**16.0**	**16.0**
Maint / Admin.	16.0	15.9	15.8	15.8	15.9	15.9
Construction	16.3	16.2	16.1	16.1	16.1	16.1
Nonhighway	16.3	16.4	16.2	16.1	16.1	16.2
Salem						
All Activities	**10.5**	**10.4**	**9.9**	**10.4**	**10.2**	**10.3**
Maint / Admin.	10.8	10.8	10.3	10.9	10.6	10.7
Construction	10.2	10.2	9.7	10.1	9.9	10.0
Nonhighway	10.1	9.9	9.5	9.8	9.6	9.8
Staunton						
All Activities	**8.3**	**8.3**	**8.2**	**8.3**	**8.3**	**8.3**
Maint / Admin.	8.8	8.8	8.7	8.8	8.8	8.8
Construction	8.0	8.1	7.9	7.9	7.9	7.9
Nonhighway	7.8	7.7	7.6	7.6	7.5	7.6
Suffolk						
All Activities	**20.0**	**19.8**	**20.0**	**19.5**	**19.7**	**19.8**
Maint / Admin.	19.6	19.5	19.7	19.1	19.4	19.5
Construction	20.2	20.0	20.3	19.8	20.0	20.0
Nonhighway	20.3	20.3	20.4	20.0	20.2	20.2

Comparisons of Allocations and Revenue Shares

This section presents a comparison of the estimated allocations shares and revenue shares. Table 4 shows the ratios of these estimates (allocation share/revenue share) for each of VDOT's four major activities and for the aggregate transportation program in each construction district from FY 88 through FY 92 and an average from FY 88 through FY 92. The ratios can be interpreted as the return on each dollar of transportation revenues raised in that district. In other words, a 5-year average ratio of 1.35 in Bristol can be viewed as a return of approximately $1.35 for each dollar Bristol deposited in the HMOF and the TTF over the 5-year period. Similarly, an average 5-year ratio of 0.88 in Staunton represents a return of approximately 88 cents for each dollar contributed by the district over the period.

Several points are apparent when examining the 5-year average ratios for all activities combined.

- With three exceptions, each VDOT construction district receives *approximately* .a dollar for dollar return for the entire transportation program, *on average*, from FY 88 through FY 92. In Culpeper, Fredericksburg, Lynchburg, Northern Virginia, Salem, and Staunton, the ratios are within a reasonable range of a ratio of 1.0.

- Those districts with 5-year average ratios substantially greater than 1.0 (Bristol and Suffolk) are net recipients of transportation funds.

- Richmond, the only district with a 5-year average ratio significantly less than 1.0, is a net donor of transportation funds.

The return on each dollar contributed has not remained stable in all nine districts over the 5-year period. In fact, the ratio of the allocations share to the revenue share for each activity in Table 4 fluctuates in roughly the same direction as the allocations share. Between FY 88 and FY 92, the average ratio for all activities decreased in eight districts and increased in one district.

- The ratio of the allocation share to the revenue share fell slightly in six districts: Bristol, Culpeper, Lynchburg, Richmond, Salem, and Staunton.

- In Fredericksburg and Suffolk, the return fell by roughly 24 cents over the analysis period.

- Over the same period, the return increased by approximately 45 cents in Northern Virginia (from 0.83 to 1.28).

Table 4
Ratio of Allocation to Revenue Shares by Construction District (FY 88-FY 92)

	FY 88	FY 89	FY 90	FY 91	FY 92	5-yr Avg.
Bristol						
All Activities	**1.35**	**1.28**	**1.41**	**1.40**	**1.30**	**1.35**
Construction	1.35	1.23	1.53	1.44	1.25	1.36
Maintenance	1.56	1.49	1.45	1.53	1.50	1.50
Administration	1.22	1.26	1.28	1.21	1.14	1.22
Nonhighway	0.22	0.28	0.32	0.30	0.34	0.29
Culpeper						
All Activities	**0.97**	**0.86**	**0.95**	**0.91**	**0.92**	**0.92**
Construction	0.83	0.78	0.96	0.86	0.74	0.83
Maintenance	1.26	1.01	0.98	0.97	1.12	1.07
Administration	1.08	1.08	1.16	1.12	1.10	1.11
Nonhighway	0.32	0.39	0.41	0.40	0.43	0.39
Fredericksburg						
All Activities	**1.06**	**0.89**	**0.98**	**0.89**	**0.82**	**0.93**
Construction	1.22	0.92	1.16	0.91	0.81	1.00
Maintenance	0.95	0.92	0.87	0.91	0.87	0.90
Administration	1.08	1.02	1.06	1.00	0.97	1.02
Nonhighway	0.24	0.26	0.29	0.26	0.30	0.27
Lynchburg						
All Activities	**1.01**	**1.01**	**1.09**	**1.05**	**1.01**	**1.03**
Construction	0.95	0.92	1.08	1.00	0.90	0.97
Maintenance	1.17	1.19	1.17	1.17	1.16	1.17
Administration	1.19	1.18	1.27	1.14	1.14	1.18
Nonhighway	0.39	0.36	0.44	0.40	0.40	0.40
Northern Virginia						
All Activities	**0.83**	**0.83**	**0.86**	**0.95**	**1.28**	**0.95**
Construction	0.67	0.66	0.71	0.89	1.53	0.90
Maintenance	0.71	0.77	0.77	0.77	0.78	0.76
Administration	1.06	1.05	0.97	1.01	1.07	1.03
Nonhighway	2.50	2.30	2.16	2.15	2.15	2.25
Richmond						
All Activities	**0.87**	**0.93**	**0.83**	**0.83**	**0.75**	**0.84**
Construction	0.94	1.03	0.82	0.78	0.65	0.85
Maintenance	0.85	0.87	0.91	0.93	0.88	0.89
Administration	0.92	0.91	0.93	0.94	0.93	0.93
Nonhighway	0.38	0.39	0.42	0.44	0.45	0.42
Salem						
All Activities	**0.89**	**0.88**	**0.96**	**0.89**	**0.85**	**0.89**
Construction	0.85	0.84	0.97	0.85	0.79	0.86
Maintenance	1.06	1.02	1.06	1.01	0.98	1.03
Administration	0.92	0.93	1.00	0.93	0.94	0.94
Nonhighway	0.23	0.30	0.28	0.28	0.27	0.27
Staunton						
All Activities	**0.88**	**0.87**	**0.94**	**0.88**	**0.82**	**0.88**
Construction	0.79	0.76	0.86	0.78	0.70	0.78
Maintenance	1.13	1.12	1.14	1.06	1.02	1.09
Administration	0.86	0.96	0.92	0.89	0.86	0.90
Nonhighway	0.17	0.21	0.24	0.21	0.23	0.21
Suffolk						
All Activities	**1.26**	**1.33**	**1.18**	**1.21**	**1.02**	**1.20**
Construction	1.46	1.55	1.32	1.39	0.96	1.34
Maintenance	0.98	1.04	1.03	1.03	1.07	1.03
Administration	0.92	0.89	0.86	0.96	0.96	0.92
Nonhighway	1.33	1.37	1.40	1.43	1.38	1.38

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To understand yearly changes in the overall ratio for all activities and the relationship of the aggregate returns to the activity returns, this section examines the returns to each of the four primary activities listed in Table 4. In order to meet the different transportation needs of regions with diverse characteristics, the program must blend the correct mix of activities within the statutory provisions of the allocations process. With the exception of Richmond, Bristol, and Suffolk, the table shows that each district receives *approximately* a dollar-for-dollar return for all activities as a whole over the 5-year period. However, for the most part, each district is a net donor for some activities and a net recipient for others. To illustrate this point, Figure 5 shows that the more rural districts (Culpeper, Lynchburg, Salem, and Staunton) are net recipients for maintenance and net donors for construction. The more urban districts (Fredericksburg, Northern Virginia, and Suffolk) receive larger returns for construction than for maintenance. Finally, note that Richmond is a net donor in both construction and maintenance, and Bristol and Suffolk are net recipients in both construction and maintenance (reflecting the relatively higher costs of construction and maintenance activities in those regions.)
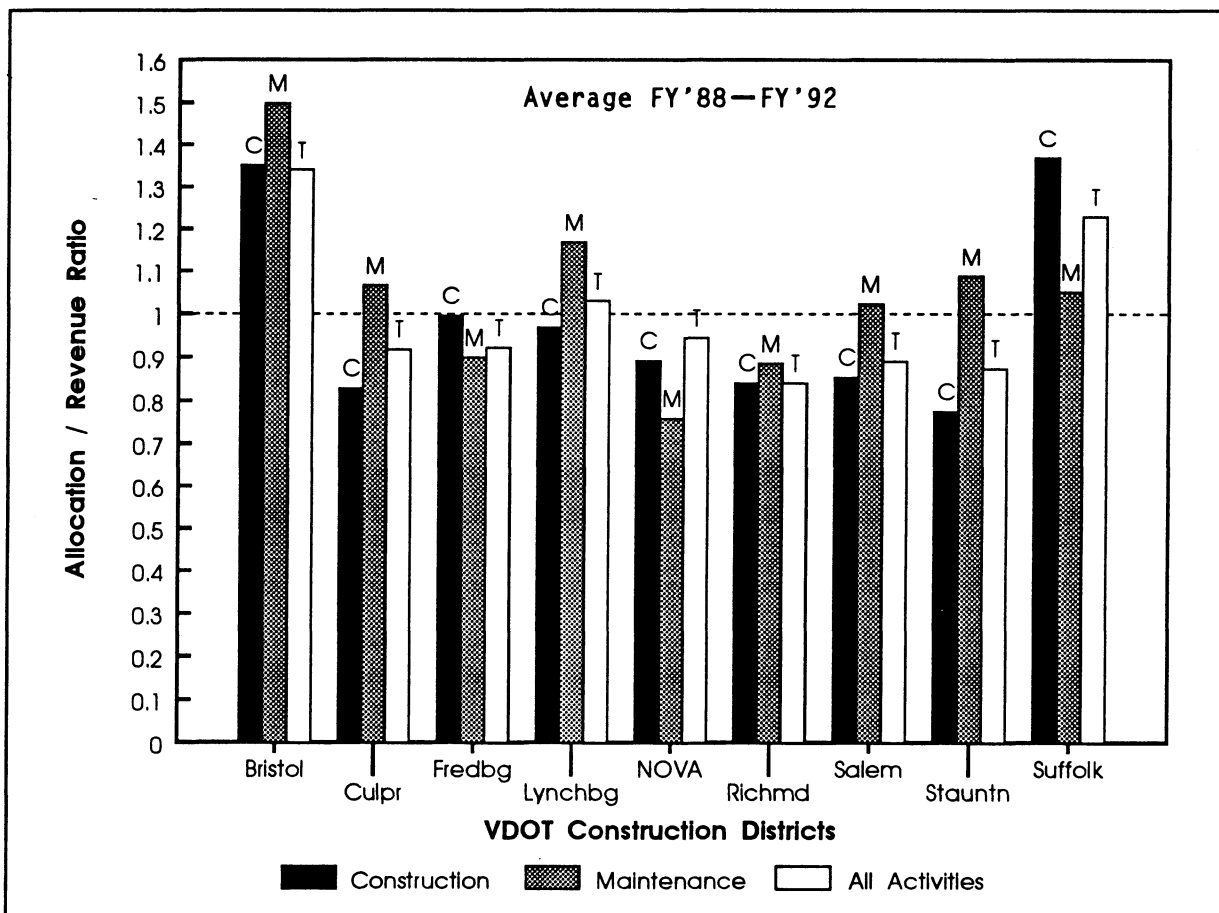
Figure 5. Revenue return: construction, maintenance, and total programs.

In addition, Northern Virginia is a net recipient in the nonhighway program, because of the programmatic emphasis placed on mass transit in that district. In every other district except Suffolk (which receives a relatively large ports allocation), however, the nonhighway return averages less than 0.50, which is far *below* the aggregate return for each district. Nevertheless, these relatively small returns have a negligible impact on each district's aggregate ratio since, as Figure 2 shows, the nonhighway allocation like the administration program makes up a small part (6 percent on average) of the aggregate for the nine districts. Alternatively, Figure 2 shows that the maintenance program makes up approximately 37 percent of the transportation program, so maintenance funding trends will have a larger impact on the aggregate return than trends in the returns to the nonhighway and administrative activities.

The point of this discussion is that the aggregate ratio represents a weighted average of the ratios for each of VDOT's four primary activities.[4] Although three of the programs--maintenance, nonhighway, and administration--exhibit relatively stable allocations and revenue trends in all nine districts over the five years (in most cases fluctuating less than one percent), Figure 5 shows that the returns generally are different from the aggregate in each district. Similarly, since the construction activity makes up only 50 percent of the total program, changes in the returns to construction activities will be larger than changes in the returns to the whole program. In Northern Virginia, for example, Table 4 shows that from FY 88 to FY 92 the aggregate return grew by $0.45, but the return to the construction program grew by almost twice that amount ($0.80). Table 4 shows that the magnitude of the relationship is similar between changes in the aggregate ratio and changes in the construction ratio in Richmond and Suffolk over the same time period. This relationship between the change in the return to each activity and the change in the overall return has important implications for how changes in the statutory allocations formulae may influence the aggregate return. More specifically, any change in an allocation formula that results in a significant change in the noninterstate construction allocation to a particular district will have a relatively small impact on the aggregate return, since the sum of the noninterstate construction activities (primary, secondary, and urban) governed by the three allocation formulae represents only 27 percent of total allocations over the five-year period. Therefore, although we do not have the tools to calculate the return to each of these highway construction programs, we can deduce from the above discussion that the ratios would be

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[4]The extent to which the ratio of one particular program differs from the overall average ratio suggests the degree to which the other ratios differ in the opposite direction. For example, if district X receives, on average, one dollar for each dollar it contributes to the entire transportation program but only $0.75 for each dollar contributed for the sum of primary, secondary, and urban construction, then it *MUST* receive *MORE* than one dollar for each dollar contributed for the sum of the remaining programs. Alternatively, if the same district receives one dollar for each dollar contributed for the sum of primary, secondary, and urban construction, then it *MUST* receive *EXACTLY* one dollar for each dollar contributed for the sum of the remaining programs.

different both from the return to all activities and from the aggregate construction return. For that reason, proposed modifications to the definition of equity in terms of matching allocations shares and revenues shares should be examined in the context of the impact on the balance of the transportation system.

CONCLUSIONS

The growing gap between transportation needs and resources has led to heightened concern about the equity of the distribution of revenues and allocations in Virginia. This research shows that with three exceptions, each VDOT construction district received *approximately* a dollar-for-dollar return for transportation revenue, *on average*, from FY 88 through FY 92. Furthermore, the dollar return to each of VDOT's four major activities--construction, maintenance, nonhighway (public transportation, rail, airports, and ports), and administration/overhead--is often very different within a particular district from the dollar return to the aggregate program. In this respect, the more rural districts, on average, are net recipients for maintenance and net donors for construction, whereas the more urban districts receive larger returns for construction than for maintenance.

Interstate construction allocations are the primary factor underlying yearly changes in the aggregate ratios of allocations to revenues. This is true for two reasons. First, allocations to the remaining programs (maintenance, transit and ports, noninterstate construction, and administration) are relatively constant over the five-year period. Second, the distribution of revenue shares remains relatively constant throughout the study period, accounting for very little of the variation in overall dollar returns. This paper has also explored the relationship between changes in the dollar return to one of VDOT's four activities and the aggregate return in a district. The yearly change in a district's dollar return to any one activity is likely to be different from the change in the aggregate return.

By examining the geographic distribution of the revenues and allocations that support the four primary activities of VDOT, we have identified some of the tradeoffs involved in providing an "efficient and balanced" statewide transportation system as called for in the VDOT mission statement. This study provides preliminary evidence that a certain flexibility exists to address the varied transportation needs of diverse geographic regions in the Commonwealth. The transportation program blends a mix of activities--construction, maintenance, nonhighway, and administration/overhead--under the statutory provisions governing the allocations process. The current programming process in conjunction with the statutory allocation formulae appears to distribute transportation resources based on current and projected future needs while at the same time providing a reasonable overall return to each district's transportation taxes and fees. In effect, some districts are net donors for some activities and net recipients for others.

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RECOMMENDATIONS

This report has shown that any alteration in the Commonwealth of Virginia's transportation allocation process which results in significant changes for districts' returns to a particular activity will have a much smaller impact on the aggregate return. For this reason, any proposed modification to the definition of equity for particular categories of activities, such as those currently being considered in the SJR-188 study, must be analyzed in the context of the impact on the balance of the system.

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Appendix A

VDOT Mission Statement/Goals

VDOT MISSION STATEMENT/GOALS

Mission:

To provide safe, efficient, effective, and environmentally sound highway and surface transportation systems now and into the Twenty-first Century.

Goals:

- Preserve and maintain the existing highway and transportation systems to safeguard the capital investment, provide for the safety, convenience and comfort of the traveling public, and provide for the efficient movement of people and goods throughout the Commonwealth.

- Design, construct, and regulate a superior highway system to enhance mobility and economic growth.

- Support and promote modal and multi-modal planning, transportation systems management, other transportation agencies and modes, and strategies to reduce urban congestion -- building new highway facilities only where necessary.

- Communicate effectively with citizens, as well as federal, state and local officials concerning highway and transportation issues, needs and priorities, funding availability, and engineering requirements.

- Ensure efficient use of existing financial resources and enhance funding through innovative financing techniques, including public-private partnerships and privatization initiatives.

- Improve productivity, quality of service, and cost reduction through use of state-of-the-art technology, research and managerial improvements.

- Recruit, develop, and manage a top quality work force and provide a stimulating and rewarding environment that encourages two-way communication and employee involvement.

Appendix B

Allocations and Revenues: Methodology

ALLOCATIONS AND REVENUES: METHODOLOGY

Introduction

This technical supplement describes the methodology we developed to distribute recommended transportation allocations and estimated revenues to the nine transportation construction districts in Virginia. The estimates of both allocations and revenues are based on information in the VDOT *Budget* and its associated *Supplement* for five fiscal years: fiscal year 1987-1988 (FY 88) through fiscal year 1991-1992 (FY 92). With two exceptions, the sources of revenue include *all* state and federal funds that flow through the HMOF and the TTF to the districts. Two adjustments were made to the supplement's figures. The first one is the exclusion of funds that "pass through" the budget without any potential for redistribution. These funds include funds from toll facilities and coal severance taxes. The second adjustment is the inclusion of only the debt service portion of bond sales in the allocations to each district since VDOT's annual liability is limited to this amount.

The first section of this technical supplement describes the procedure we used to distribute recommended allocations to each district for every program in the budget. The second section presents the models we developed to estimate the geographic distribution of transportation revenues generated in each district.

Allocations

This section describes the methodology we developed to attribute recommended allocations (*not* actual expenditures) of state and federal funds that flow through the HMOF and TTF to the nine construction districts in Virginia. The VDOT *Budget* itemizes the allocation of funds to each construction district for every transportation program in Virginia. These programs are summarized on the last page of each VDOT *Budget Supplement* (FY 89-FY 92) in a table titled "Distribution of Allocated Funds By Location." To serve as an example, Table B-1 illustrates the summary table for FY 90. The summary table was not available for FY 88; therefore, we used information in the budget to create one. A small portion of the funds, roughly 10 percent on average, is not directly distributed to the nine construction districts within the budget. Instead, it is classified as either "Central Office" or "Statewide/Other." The methodology we developed to distribute these "Central Office" and "Statewide/Other" allocations to the nine construction districts is the focus of this section.

For most of the transportation programs, the "Central Office" and "Statewide/Other" allocations can be viewed as overhead expenses. We distributed these allocations according to the share of budgeted allocations in each district for that program. For example, if the Culpeper District received 5.4 percent of the geographically distributed funds of the Physical Plant program (*not* including "Central Office" or "Statewide/Other"), then it was estimated that

Culpeper received 5.4 percent of the "Central Office" and "Statewide/Other" funds. The reasoning is as follows: the size of the Central Office effort required to maintain each of these programs is related to the size of the program in each district and therefore is likely to benefit each geographic area in relation to its share of the existing program total. For other programs in this category, the "Central Office" and "Statewide/Other" allocations consist of "reserve funds" or "emergency reserves." In general, over time these reserves are likely to be dispersed in proportion to the existing program allocations. Each of these programs will be discussed in the next section; they include Administration/Supervision, Physical Plant ("Statewide/Other"), Highway Vehicle Regulation, Interstate Construction, Primary Construction, Urban Construction, Construction Management, HPR & Financial Planning Assistance ("Statewide/Other"), Interstate Maintenance, Primary Maintenance, Secondary Maintenance, City Street Maintenance, and County Road Maintenance.

Alternatively, for several other transportation programs, the "Central Office" and "Statewide/Other" allocations can be distributed to each of the nine construction districts using information contained in the budget for that program or using information obtained from the central office division that administers the program. The method used for each program is described below. They include Access Roads and Other Construction, Toll Facilities Revolving Account, and the U.S. Route 58 Corridor Development Program.

The "Central Office" allocation for three program areas is distributed by the share of the Administration/Supervision program in each district. It is reasoned that the function of the Central Office is to support the district operations and to set statewide policies. Therefore, the extent of the Central Office support dictates the size of these programs required to fulfill this task. These programs include Computer Services, Physical Plant ("Central Office"), and Capital Budget.

The "Central Office" and "Statewide/Other" allocations to several programs are distributed to the nine construction districts based on the share of total state population in each district. It is reasoned that these programs benefit the state in proportion to the population. Population is an indirect measure of the demand for these programs in each geographic area. These programs include Ground Transportation System Planning and Research, HPR and Financial Planning Assistance ("Central Office"), Mass Transit Assistance, and Transfers to Other State Agencies.

For the remaining programs not mentioned above, we have used alternative methods to distribute "Central Office" and "Statewide/Other" allocations. In the following sections, we will describe the distribution process on a program-by-program basis.

Table B-1

FISCAL YEAR 1989-90

DISTRIBUTION OF ALLOCATED FUNDS BY LOCATION

PROGRAM	PROGRAM #	BRISTOL	SALEM	LYNCHBURG	RICHMOND	SUFFOLK	FREDERICKSBURG	CULPEPER	STAUNTON	NO. VIRGINIA	CENTRAL OFFICE	STATEWIDE/OTHER	PROGRAM TOTAL
Admin. & Supervision													
Computer Services													
Physical Plant Services													
Highway Vehicle Reg.													
Ground Trans./Urban Pl.													
Access Rd/Other Constr.													
Interstate Construction													
Primary Construction													
Secondary Construction													
Urban Construction													

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Administration/Supervision

The "Central Office" and "Statewide/Other" allocations for the Administration/Supervision program fund central office administrative support for the entire transportation program. We assumed that each district would benefit from this function in roughly the same proportion as its share of the Administration/Supervision program (A/S share) since that share can be used to represent the relative effort required to administer the entire transportation program in that area. Therefore, we used the A/S shares to distribute the "Central Office" and "Statewide/Other" allocations to the nine districts.

Computer Services

The "Central Office" allocation for the Computer Services Program provides funds for the Information Systems Division of VDOT. This division supports the transportation program through data analysis and the provision of computer hardware and software. Given the administrative nature of this division, we assumed that each district would benefit from this support in roughly the same proportion as its share of the Administration/Supervision Program. Therefore, we distributed these funds to the districts on the basis of the A/S shares.

Physical Plant

The Physical Plant Program administers buildings and grounds maintenance. In this category, the "Central Office" and "Statewide/Other" allocations serve distinctly different purposes. Therefore, we must examine their geographic distribution individually.

The "Central Office" allocation for the Physical Plant Program funds the Central Office infrastructure. We assumed that each district would benefit from this program through its support from the Central Office in roughly the same proportion as its share of the Administration/Supervision Program. Therefore, we distributed these funds to the districts on the basis of the A/S shares.

The "Statewide/Other" allocation for the Physical Plant Program funds worker's compensation and special physical plant needs throughout the state. We assumed that on average these needs would be distributed to each district in roughly the same proportion as its physical plant allocation. Therefore, we distributed these funds geographically based on each district's share of the Physical Plant Program.

Highway Vehicle Regulation

The "Central Office" and "Statewide/Other" allocation for the Highway Vehicle Regulation Program primarily funds the field operations and administrative components of the truck weighing operations. We assumed that on average, each district would benefit from this support function in roughly the same proportion as its share of the Highway Vehicle Regulation Program. Therefore, we distributed these funds geographically based on each district's share of the program allocation.

Ground Transportation System Planning and Research

The "Statewide/Other" allocation for the Ground Transportation System Planning and Research Program funds the Virginia Transportation Research Council. The Council conducts basic transportation research and provides technical assistance to VDOT. We assumed that the beneficiaries of the Council's research and practical analysis are the citizens of Virginia and all motorists who travel through the state. Therefore, we distributed these funds geographically based on each district's share of the state's population.

Access Roads and Other Construction

The "Statewide/Other" allocation for the Access Roads and Other Construction Program funds several small-scale construction activities supported by VDOT. Since we had access to detailed data, we distributed these funds geographically by analyzing the *actual* allocation patterns for each activity. First, we detailed the "Statewide/Other" allocation for each subprogram of the Access Roads and Other Construction Program. These subprograms include Access Roads, Revenue Sharing, Coal Severance Tax Roads, Forest Highways, Interstate Transfer, Appalachian Program, and Demonstration Projects. The remainder of the estimation procedure is presented below for each subprogram.

Access Roads. There are five Access Roads activities: Industrial Access, Recreational Access, Airport Access, Industrial Railroad Access, and Bicentennial and Cultural Access. We used *actual* allocations reported by VDOT personnel (see below) in each fiscal year to determine each district's share of the first four Access Road Activities. Then we applied these shares to the recommended allocation for each activity in the budget to distribute the "Statewide/Other" funds to the nine districts. This process was necessary since the budget reports estimated allocations not actual allocations. Finally, the Bicentennial and Cultural Access activity provided funding solely for access roads to the Museum of American Frontier Culture in the Staunton district in FY 89 and FY 90. Our sources for the *actual* allocations are as follows:

o Industrial Access, Recreational Access, Airport Access
  Carol Pollock, Secondary Roads Division - VDOT

o Industrial Railroad Access
   Bill Ketron, Rail & Public Transportation Division - VDOT

Revenue Sharing. The "Statewide/Other" allocation for the Revenue Sharing subprogram provides both the state and local contributions to this subprogram. We used *actual* district allocations in each fiscal year to calculate each district's share of the subprogram. Since the recommended subprogram allocation reported in the budget differed somewhat from the *actual* allocations, we used the district · shares to distribute the "Statewide/Other" allocations geographically to the nine districts.

Source for *actual* Revenue Sharing allocations:
   Carol Pollock, Secondary Roads Division - VDOT

Coal Severance Tax Roads. The coal severance tax is imposed on mining companies by some southwestern Virginia localities. The tax revenues are allocated directly to the localities that impose the tax. Therefore, it is a "pass-through" fund, both generated and spent in the same geographic area. As stated earlier in this report, such "pass-throughs" were not considered in this analysis, so we deducted the full subprogram amount from the total allocations under consideration.

Forest Highways. The "Statewide/Other" allocation for the Forest Highways subprogram is used to construct access roads to national forests. We assumed that over time these funds are used roughly in proportion to each locality's share of national forest area in the state. We derived these shares from the *Virginia Statistical Abstract*, Table 7.6A (Center for Public Service, 1989), which lists the 1986 square mileage of national forest area in Virginia localities. Since this area changes very little from one year to the next, we used the 1986 shares to distribute these funds geographically in each fiscal year in the analysis.

Appalachian Regional Highway System. The Appalachian subprogram is a federal-aid program that receives matching funds from the Commonwealth of Virginia to assist the Appalachian region. These funds have been used historically for both the construction of access roads and the development of transportation corridors. Ron Knakal (Programming and Scheduling Division - VDOT) reported that the Salem district received some of this funding in the early 1980s and that the Bristol district has received the entire allocation in each year since the mid 1980s. Therefore, we distributed all Appalachian funds to the Bristol district.

Demonstration Projects. Each year federal aid to Virginia includes a number of demonstration projects targeted for specific localities. Therefore, we distributed these funds according to each district's actual demonstration project allocation.

Construction Programs: Interstate, Primary, Secondary, and Urban

Construction funds are allocated in the budget to the nine construction districts for each of Virginia's four highway systems: interstate, primary, secondary, and urban. The geographic distribution is governed largely by programming and planning decisions for the Interstate system, and by legislative formulae for the Primary, Secondary, and Urban systems. The "Statewide/Other" allocation consists of resurfacing expenditures for the interstate system (FY 88 only), unallocated balances for the primary system, and the 2 percent local match for the urban system. We assumed that on average, each district would benefit from these funds in roughly the same proportion as its share of each program total. Therefore, we distributed these funds geographically according to each district's share of the particular system's total allocation.

Construction Management

The Construction Management Program facilitates VDOT's construction mission for all four highway systems. We assumed that this support function would be used by each district roughly in proportion to its share of *total* construction funding (the combination of interstate, primary, secondary, and urban construction funding). Therefore, we distributed the "Central Office" and "Statewide/Other" allocations geographically based on each district's share of the aggregate construction program.

In addition, in FY 88, a "Critical Construction Fund" was included in the VDOT budget. The "Statewide/Other" allocation, totaling $1.5 million, was earmarked for the procurement of engineering equipment. We assumed that the equipment was used by each district in roughly the same proportion as its share of the Critical Construction Program Fund. Therefore, we distributed these funds according to each district's share of the Critical Construction program.

Highway Planning & Research (HPR) and Financial Assistance for Transportation Planning

The HPR and Financial Planning Assistance Program assists transportation system planning throughout the Commonwealth. A large portion of the funds are distributed directly to Metropolitan Planning Organizations (MPOs). The "Central Office" allocation provides funds to the Transportation Planning Division, which, among other functions, assists MPOs with statewide planning. We assumed that the planning function benefits localities in proportion to their share of Virginia's population. Therefore, we distributed these funds geographically based on each district's share of the state's population. The "Statewide/Other" allocation includes unallocated balances, funds for training, and other miscellaneous planning functions. Since these functions support the entire planning program, we distributed the funds geographically based on each district's share of the HPR and Financial Planning Assistance Program.

Maintenance Programs: Interstate, Primary, and Secondary

A primary VDOT responsibility is the maintenance of Virginia's transportation network. The majority of the funding for maintaining the interstate, primary, and secondary systems is distributed geographically to each district in the budget. The "Statewide/Other" allocation to the Maintenance Programs funds each system's maintenance reserve fund and the maintenance emergency fund. We assumed that each district would benefit from these reserve funds in roughly the same proportion as its share of the particular maintenance program. Therefore we distributed the funds based on each district's share of the particular system's maintenance program total.

City Street Maintenance

VDOT also provides cities and towns in Virginia with street maintenance funds. The majority of city street maintenance funds are distributed geographically in the budget. The "Statewide/Other" allocation consists of unallocated balances that we assumed would benefit each district in roughly the same proportion as its share of the City Street Maintenance Program. Therefore, we distributed the funds based on each district's share of the program total.

County Road Maintenance

The County Road Maintenance Program is used to assist the two Virginia counties that opted out of the statewide secondary system in 1932--Arlington and Henrico. The "Statewide/Other" allocation consists of unallocated balances that we assumed would benefit each district in roughly the same proportion as its share of the County Road Maintenance Program. Therefore we distributed the funds based on each district's share of the program total.

Ground Transportation System Safety

The Ground Transportation Safety Program supports research and analysis conducted by the Traffic Engineering Division. The traffic counts, roadway inventory, and other routine operations performed by the Traffic Engineering Division as part of this program are closely related to the Department's maintenance activities. We assumed that each district would benefit from the ground transportation safety program in roughly the same proportion as its share of the total maintenance program (interstate, primary, and secondary). Therefore, we distributed the "Central Office" and "Statewide/Other" allocations to each district based on its share of the total maintenance program.

Toll Facilities - Toll Facilities Revolving Account

The VDOT budget supplement breaks down the Toll Facilities Program into several subprograms: acquisition and construction, debt service, maintenance and operation, and Toll Facilities Revolving Account (TFRA). The first three subprograms are "pass throughs," so we excluded them from the analysis.

However, the TFRA is not a pass-through fund. A portion of the interest earnings on the TTF is used to fund the TFRA. We used allocation information about specific projects slated to be funded by the TFRA (such as improvements to the Virginia Beach/Norfolk Expressway - VA44) in the *Six-Year Improvement Program* to supplement the data in the budget to distribute the "Statewide/Other" allocation to each district.

Mass Transit Assistance

Most of the funding for the Mass Transit Assistance program is distributed geographically in the budget supplement. Northern Virginia receives the major proportion of these funds for its extensive METRO system. The "Statewide/Other" allocation funds several subprograms, including ridesharing assistance, discretionary funds, promotional and operational studies, and others. We assumed that these subprograms benefit each district in roughly the same proportion as its share of the state's population. Therefore, we distributed these funds geographically based on each district's share of the total population.

Outdoor Advertising

The "Statewide/Other" allocation for the Outdoor Advertising Program funds the regulation of outdoor advertising on the state's transportation network. Based on discussions with the Budget Division, we assumed that each district benefits from this regulation function in roughly equal proportions. Therefore, we distributed these funds equally to all districts.

Capital Budget

The "Central Office" and "Statewide/Other" allocations for the Capital Budget Program are used to enhance the transportation network statewide through capital improvements to the central office and miscellaneous capital improvements throughout the state. Given the administrative function of the central office, we assumed that each district would benefit from these improvements in roughly the same proportion as its share of the Administration/Supervision Program. Therefore, we distributed these funds based on the A/S shares.

Other State Agencies

The "Statewide/Other" allocation for the Other State Agencies Program provides financial support for other state agencies that further the transportation goals of the Commonwealth, including the State Police, the Department of Education, and the Office of the Secretary of Transportation. We assumed that since the basic purpose of this funding is to support the entire state's transportation system, each district would benefit from the program in roughly the same proportion as its share of the total population. Therefore, we distributed the funds geographically based on each district's share of state population.

Other Transportation Modes

The "Statewide/Other" allocation for the Other Transportation Modes Program provides funding to Virginia's ports and airports. Given that all ports are in the Tidewater region of the Commonwealth, we distributed the port funding entirely to the Suffolk District. The airports that tend to receive assistance from this fund are generally smaller regional facilities. Since these airports are located throughout the state, we assumed that each district benefits from the airport funding in roughly equal proportions. Therefore, we distributed the airport funds equally to each district.

Trust Fund Management

The "Central Office" and "Statewide/Other" allocation for the Trust Fund Management Program funds VDOT's activities to manage transportation funds. VDOT works with both the Treasury Department and the Department of Taxation to perform this function. We assumed that each district benefits from this activity in roughly the same proportion as its share of total allocations from the fund. Therefore, we distributed these funds geographically based on each district's share of total allocations.

Revenues

Transportation revenues in the Commonwealth of Virginia are managed through two funds, the Highway Maintenance and Operating Fund (HMOF) and the Transportation Trust Fund (TTF). Revenues from different sources, such as the motor vehicle fuels tax, and the motor vehicle sales and use tax, among others, are deposited in either the HMOF or the TTF based on specifications in the *Code of Virginia*. In this section, we describe the method we developed to geographically distribute the revenues from each fund.

We estimated the geographic distribution of each revenue source (i.e., motor vehicle fuels tax, road tax, etc.) based on modeling techniques and actual historical data. In many cases,

modeling was necessary because certain revenues are not collected by geographic region. The VDOT budget serves as a basis for our analysis; it details the contribution of each revenue source to the HMOF and the TTF (see Table B-2).

Table B-2
HMOF and TTF Revenues, by Source, FY 88-FY 92 (in thousands of current dollars)

	FY 88	FY 89	FY 90	FY 91	FY 92
Highway Maintenance and Operating Fund					
Motor Fuel Taxes	$432,483	$510,469	$534,262	$541,980	$515,636
MV Sales & Use Tax	$170,971	$182,740	$186,901	$174,818	$178,931
MV License Fees	$98,582	$116,972	$113,579	$104,518	$107,884
Federal Revenue	$336,965	$389,785	$262,514	$306,068	$388,668
Truck Fees	$32,675	$34,943	$39,959	$44,841	$44,296
Misc. Revenue	$12,500	$12,600	$8,000	$12,920	$12,500
Transportation Trust Fund					
Motor Fuel Taxes	$168,244	$81,866	$83,858	$83,519	$80,202
MV Sales & Use Tax (incl. Rental Tax)	$99,377	$105,054	$107,396	$99,671	$101,762
State Sales & Use Tax	$208,800	$211,800	$228,900	$235,134	$241,156
MV License Fees	$14,253	$16,744	$16,074	$14,502	$16,255
Road Tax	$6,487	$4,988	$5,197	$4,984	$5,126
Misc. Revenues	$10,756	$9,758	$13,276	$30,171	$31,933
TOTAL	$1,592,093	$1,677,719	$1,599,916	$1,653,126	$1,724,349

Source: VDOT budgets, FY 88-FY 92.

We combined the budget revenue estimates with supplemental data to construct models of the geographic distribution of transportation revenues. The models are described in order of the relative magnitude of the revenue sources. For example, Figure B-1 shows that combined state and federal fuels taxes make up over 50 percent of total transportation revenues, so the distribution of fuels taxes will be discussed first, followed by motor vehicle sales and use taxes, state sales and use taxes, motor vehicle license fees, federal grants and contracts, receipts from cities and towns, toll revenues, miscellaneous revenues, and interest.

HMOF & TTF Combined - Average FY88-FY92

- Federal Fuels Tax (17.0%)
- Federal Truck Fees (3.3%)
- Other State Rev (4.6%)
- MV License (7.5%)
- State Sales & Use (13.7%)
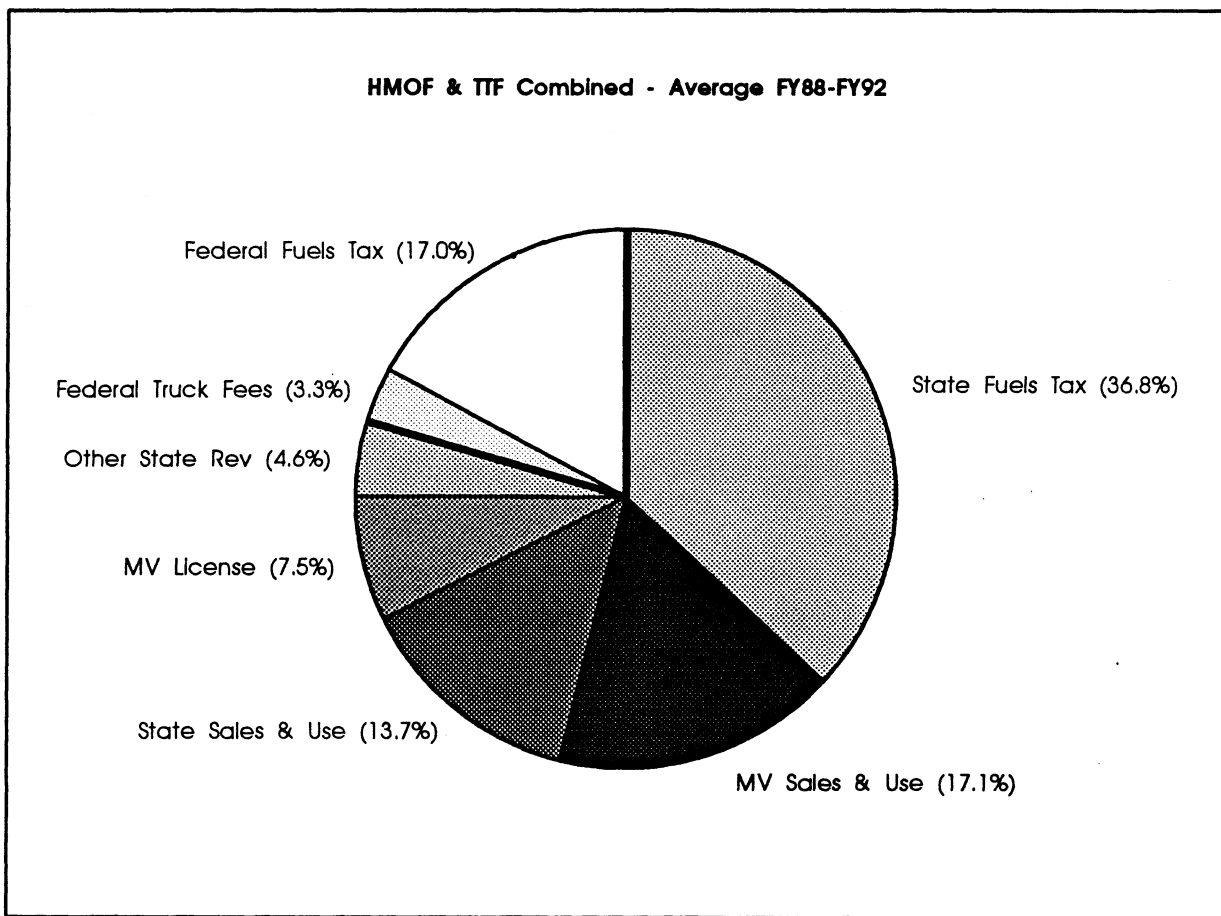- State Fuels Tax (36.8%)
- MV Sales & Use (17.1%)

Figure B-1. Transportation revenue sources.

Source: VDOT budgets FY 88-FY 92, excluding "pass-throughs."

Motor Fuel and Special Fuels Taxes

As shown in Figure B-1, more than 50 percent of total transportation revenues are generated by combined state and federal fuels taxes. The state and federal fuels tax data are reported in the aggregate for the entire state[5]. Neither of these revenue sources is available by locality, since Virginia collects both state and federal fuels taxes statewide at the distributor level. Consequently, there is no way to determine the *exact* number of gallons of fuel sold in each locality, or even in each VDOT construction district. For this reason, we developed a model based on the only fuels tax data available by locality in Virginia. These 10 localities make up the "special tax districts" comprised of the Northern Virginia and the Potomac and Rappahannock Transportation Districts. These districts have the authority to impose fuel taxes above the standard federal and state levels in order to help meet transportation needs in the region. Table B-3 lists FY 91 revenues from the locally-imposed 2 percent retail pump price fuels tax for each locality in the special tax districts.

This data set allowed us to test a range of theoretical regression specifications to identify the most accurate fuels tax model for the Northern Virginia sample. We considered several independent variables for this theoretical model, including: population, population density, various income measures (median adjusted gross income and average adjusted gross income), land area, vehicle registrations, and vehicle miles traveled (VMT).[6] Although these 10 localities do not represent a true random sample, the diversity of the region (from relatively urbanized Alexandria to the more rural Loudoun County) reflects the diversity of the Commonwealth's 9 transportation districts, from the relatively urbanized Northern Virginia District to the more rural Bristol District. Furthermore, it is most appropriate to test and estimate a theoretical model with actual data, and as previously stated, the gas tax data set for the Northern Virginia sample is the only available relevant data.

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[5]According to the FHWA publication *Highway Statistics*, Table FE-9 (1988-1990), approximately 84 percent, on average, of federal revenues raised in Virginia are derived from fuel taxes. The remaining 16 percent is collected from various truck fees. We applied this share (84 percent) to the projection of federal revenues in the VDOT budgets (FY 88-FY 92) to estimate the dollar amount of federal fuel taxes raised in Virginia.

[6]The use of VMT as an independent variable in the fuels tax model leads to several serious problems. First, interstate VMT is unacceptable since the Lynchburg district has no interstate highways. Second, the most recent assessment of VMT on the secondary system occurred in 1986. Third, the use of primary VMT alone would not accurately represent the combination of travel on the three systems. Therefore, we chose not to use this variable in the statistical model.

Table B-3
2%-Pump Price Fuel Tax Revenue: Northern Virginia and Potomac and Rappahannock Transportation Districts, FY 91

Locality	FY 91 Revenue
Northern Virginia	
Fairfax County	$8,091,624
Arlington County	$1,440,119
Alexandria City	$1,168,571
Loudon County	$1,164,472
Fairfax City	$ 665,209
Falls Church City	$ 238,091
Potomac & Rappahannock	
Prince William County	$2,630,173
Stafford County	$1,030,926
Manassas City	$ 429,539
Manassas Park City	$ 142,359

Source: Virginia Department of Taxation.

The most accurate model we developed for the Northern Virginia sample included both vehicle registrations and population density as explanatory variables (hereafter referred to as the VTRC model). In order to determine whether the VTRC model provides a significant increase in accuracy over other models, we also tested a registrations model and a population model for the Northern Virginia sample. These models are based on the assumption that each locality's share of fuels tax revenues is exactly equivalent to either its share of vehicle registrations or its share of population[7]. Although not regression models, the registration and population models can be compared statistically to the VTRC model based on how well they "fit" the Northern Virginia sample (see Table B-4).

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[7]The two variables should not be used in the same equation since they are highly correlated (correlation coefficient of 0.9995).

Table B-4
Comparative Statistics - Alternative Fuels Tax Models

Statistic	VTRC Model	Registration	Population
Adjusted R^2	0.99	0.98	0.97
Standard Error	0.01	0.02	0.03

The statistics show that the VTRC model, which utilizes both vehicle registrations and population density, models the Northern Virginia sample most accurately. Although all three models have relatively strong explanatory power (R^2 > 0.96), the standard errors of the alternative models are at least twice that of the VTRC model. This indicates that the VTRC multiple regression model captures a larger share of the dynamics of regional fuel consumption.

The full specification of the VTRC model is displayed in Table B-5. The T-statistics indicate that the coefficient estimates are statistically significant. In addition, an F-test indicates that the additional components of the VTRC model (population density and a constant) are significant when compared to the registrations model. The computed F statistic is 10.59, more than twice the critical value of 4.74 at a 95 percent confidence level; therefore, the VTRC specification is the most accurate model that we tested for the Northern Virginia sample.

Table B-5
VTRC Multiple Regression Fuels Tax Model Specification

Term	Coefficient	T Statistic
Registration	+ 0.8998	36.6
Population Density	- 0.1145	-2.6
Constant	+ 0.0215	3.4

Perhaps most importantly, this model is reasonable from a theoretical viewpoint. First, as seen in Table B-4, the number of vehicle registrations is strongly related to fuel tax revenue. As population density rises, however, the availability of public transportation services generally increases. Increased public transportation usage and carpooling should lead to lower fuel usage per registered vehicle and consequently, to lower fuels tax revenues per registered vehicle. This relationship is represented in the small negative coefficient for population density in the model. Furthermore, the much larger geographic area covered by the construction districts eliminates part of the cross-border transactions identification problems associated with locality-level data. In other words, the process of aggregating the localities to the district level implicitly assumes that the VMT is generated in the same geographic area that the gas tax is paid. Alternatively, if the model were to use locality data, there would be a much smaller likelihood that VMT and gas tax revenues were generated in the same geographic area. We apply the model using the

coefficients in Table B-5 to distribute fuels tax revenues to the nine VDOT construction districts in the following manner.[8]

$$FUEL^t_{D_d} = (0.8998) \times REG^t_{D_d} + (-0.1145) \times DENS^{90}_{D_d} + (0.0215) \text{ , for } t = \text{FY88-FY91.}$$

$$FUEL^t_{D_d} = (0.8998) \times REG^{91}_{D_d} + (-0.1145) \times DENS^{90}_{D_d} + (0.0215) \text{ , for } t = \text{FY92.}$$

where

$FUEL^t_{D_d}$ = the share of projected statewide fuels tax revenues (combined state & federal) for D_d in year t,

$REG^t_{D_d}$ = the share of statewide vehicle registrations for D_d in year t,

$DENS^{90}_{D_d}$ = the share of Virginia's population density for D_d in 1990, which can be expressed as:

$$\frac{(Population\ Density)^{90}_{D_d}}{\sum_{d=1}^{9} (Population\ Density)^{90}_{D_d}}$$

t = FY88-FY92,
D_d = 9 VDOT construction districts.

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[8]An application of the VTRC model for FY 90 is displayed in the following table. The nonregression-based registration and population models were also applied and are displayed in the table for comparison purposes.

District	VTRC Model	Registration	Population
Bristol	7.27%	5.92%	5.97%
Culpeper	6.17%	4.76%	4.33%
Fredericksburg	6.71%	5.41%	4.64%
Lynchburg	7.42%	6.08%	5.84%
Northern Virginia	17.70%	23.54%	23.67%
Richmond	15.54%	15.60%	15.27%
Salem	10.63%	9.83%	9.63%
Staunton	8.71%	7.52%	6.60%
Suffolk	19.85%	21.35%	24.04%

Motor Vehicle Sales and Use Taxes

The Department of Motor Vehicles (DMV) collects and reports motor vehicle sales and use taxes by locality. At the time of the analysis, the data were only available for FY 89 and FY 90. The data are based on the locality in which each vehicle is garaged. We combined these actual revenue collections with the revenue projections in the VDOT budget to derive an estimate of each district's motor vehicle sales and use tax revenues[9]. The model can be represented as follows:

$$MVS_{L_i}^t = (TMVS^t) \times (MVSSHR_{L_i}^{89}), \quad \text{for FY88, FY89;}$$

$$MVS_{L_i}^t = (TMVS^t) \times (MVSSHR_{L_i}^{90}), \quad \text{for FY90, FY91, FY92;}$$

$$MVS_{D_d}^t = \sum_{L_i \in D_d} MVS_{L_i}^t, \quad \text{for FY88-FY92;}$$

where:

$MVS_{L_i}^t$ = motor vehicle sales & use revenues for L_i,

$TMVS^t$ = total motor vehicle sales & use revenues projections from VDOT Budget,

$MVSSHR_{L_i}^t$ = share of total motor vehicle sales & use revenues for L_i derived from DMV actual figures,

MVS_{D_d} = motor vehicles sales & use revenues for district D_d,

L_i = cities and counties,
t = FY88-FY92,
D_d = 9 VDOT construction districts.

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[9]This report is based on VDOT budget estimates since the intent is to describe the allocation process using the exact same information available to decision makers at the time the allocations recommendations are developed. In other words, the information available to these policy makers is limited to estimated state revenues. These data differ from DMV reports of actual figures. The procedure described in this section ensures that the VDOT estimates are distributed geographically according to actual shares of locality data.

Motor Vehicle License Fees

The DMV also collects and reports the number of registered vehicles in Virginia by locality. The data are available for FY 88-FY 91 and are available based on the locality in which the vehicle is garaged. Since all registered motor vehicles in the Commonwealth are assessed a license fee, we used this registration count data to estimate the amount of motor vehicle license fees generated by each locality within the nine VDOT construction districts. The model can be represented as follows:

$$MVLF^t_{L_i} = (TMVLF^t) \times (MVRSHR^t_{L_i}) \quad \text{for } t = \text{FY88-FY91};$$

$$MVLF^t_{L_i} = (TMVLF^t) \times (MVRSHR^{91}_{L_i}) \quad \text{for } t = \text{FY92};$$

$$MVLF^t_{D_d} = \sum_{L_i \in D_d} MVLF^t_{L_i} \quad \text{for FY88-FY92};$$

where

$MVLF^t_{L_i}$ = motor vehicle license fees for L_i,

$TMVLF^t$ = total motor vehicle license fees: projections from VDOT Budget,

$MVRSHR^t_{L_i}$ = share of total motor vehicle registrations for L_i derived from DMV counts,

$MVLF^t_{D_d}$ = motor vehicle license fees for district D_d,

L_i = cities and counties,
t = FY88-FY92,
D_d = 9 VDOT construction districts.

State Sales and Use Tax

The Department of Taxation records receipts of the state sales and use tax (4.5 percent retail sales tax) by locality. A portion of the tax (0.5 percentage point) is dedicated to the TTF and makes up approximately half of the TTF (excluding tolls and other "pass-throughs"). The tax is credited to the locality in which the retail sale is made. We aggregated these data by district to distribute the projected sales tax revenues published in the VDOT budget. The model can be represented as follows:

$$STR_{L_i}^t = (STSHR_{L_i}^t) \times (TOTSTR^t) \quad \text{for } t = \text{FY88-FY91};$$

$$STR_{L_i}^t = \left(\frac{STRSHR_{L_i}^{90} + STRSHR_{L_i}^{91}}{2} \right) \times (TOTSTR^t) \quad \text{for } t = \text{FY92};$$

$$STR_{D_d}^t = \sum_{L_i \in D_d} STR_{L_i}^t \quad \text{for FY88-FY92};$$

where:

$STR_{L_i}^t$ = estimated sales tax revenue for L_i,

$TOTSTR^t$ = total sales tax revenue: projections from VDOT budget,

$STSHR_{L_i}^t$ = share of actual sales tax revenues for L_i (derived from Dept. of Taxation data)

L_i = cities and counties,
t = FY88-FY92,
D_d = 9 VDOT construction districts.

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Federal Revenue

Virginians support transportation at the federal level primarily through motor fuels taxes and various large-truck fees. We assumed that the amount of federal revenue generated by Virginia is equal to the amount of federal funding projected in the VDOT budget, which generally accounts for 20 percent to 30 percent of the HMOF.[10] In addition to our fuels tax model, we developed a large-truck road usage model to distribute the revenue geographically. We calculated the share of total revenue derived from each category (see Table B-6). At the time of our analysis, the FHWA had not yet published data for FY 91 and FY 92. Given that the shares for FY 89 and FY 90 were relatively constant, we assumed shares of 84 percent for fuels tax revenues and 16 percent for large-truck fees for FY 91 and FY 92.

Table B-6
Federal Revenues in Virginia by Source (Percentage)

Category	FY 88	FY 89	FY 90
Fuel Tax Revenue	82.0%	84.2%	84.1%
Large-Truck Road Usage Fees	18.0%	15.8%	15.9%
TOTAL	100.0%	100.0%	100.0%

Source: Derived from Table FE-9, FHWA *Highway Statistics*, 1988-90.

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[10]The redistributive nature of federal allocations is beyond the scope of this analysis. Federal revenues in this analysis include only those that are returned to Virginia by the federal program. For example, in FY 90, Virginia generated approximately $331.55 million in federal user charges according to estimates made by the FHWA. In that same year however, only 94.7 percent of that amount ($314.135 million) was returned to the state in federal grants and contracts. The methodology in this paper excludes the "surplus" contribution to the federal program since it is not part of "allocable" Virginia transportation funds.

The large-truck road usage model estimates the share of large-truck traffic in each construction district. We use these estimates to calculate the dollar amount of truck user fees generated in each district. The model is based on data from the 1991 Cost Responsibility Study. We utilized the Highway Performance Monitoring System (HPMS) to estimate the large-truck VMT on each of the four highway systems. Table B-7 shows the shares of large-truck VMT on each system statewide.

Table B-7
Large-Truck VMT in Virginia - 1990 by System (Percentage)

System	Truck VMT Share
Interstate	0.552
Primary	0.297
Secondary	0.063
Urban	0.088
TOTAL	1.000

Source: Derived from HPMS Data

To estimate each district's share of large-truck traffic, we used these system VMT shares as a multiplier for lane mileage, by system, within each district. This model can be represented as follows:

$$T_{D_d}^t = 0.552 \times (I_{D_d}^{90}) + 0.297 \times (P_{D_d}^{90}) + 0.063 \times (S_{D_d}^{90}) + 0.088 \times (U_{D_d}^{90}),$$

where:

T_{D_d} = share of large-truck traffic for D_d,

I_{D_d} = share of interstate lane mileage for D_d in 1990,

P_{D_d} = share of primary lane mileage for D_d in 1990,

S_{D_d} = share of secondary lane mileage for D_d in 1990,

U_{D_d} = share of urban lane mileage for D_d in 1990,

D_d = 9 VDOT construction districts,
t = FY88-FY92.

Applying this formula to 1990 interstate, primary, and secondary lane mileage figures obtained from the Traffic Engineering Division and the 1990 urban lane mileage figures from the Urban Division, truck usage shares were obtained for each district. We assumed that the shares calculated using 1990 data will remain relatively constant over the five-year study period., Therefore, the shares listed in Table B-8 were used to distribute truck-related fees geographically for every year of the analysis (FY 88 - FY 92).

Table B-8
Large-Truck Usage by District FY 88-FY 92 (Percentage)

District	Large-Truck Usage FY 88 - FY 92
Bristol	10.95%
Culpeper	6.43%
Fredericksburg	6.74%
Lynchburg	5.24%
Northern Virginia	9.22%
Richmond	20.40%
Salem	11.21%
Staunton	15.31%
Suffolk	14.50%
TOTAL	100.00%

Miscellaneous Truck Fees

Virginia imposes a variety of fees on trucks in order to ensure that they contribute to their use of the state's transportation facilities. These fees comprise approximately 3 percent of the total funds considered in this analysis. For the most part, these fees are only applied to large trucks. We applied the large-truck usage model described in the federal revenue section to distribute these revenues. The funding categories distributed by this method include: Road Tax, International Registration Plan (IRP), Overload Permits, Mileage Permit Fees, Hauling Permit Fees, Highway Permit Fees, Truck Weighing Fees, Liquidated Damages - Weight Violations, Interagency Revenue Transfer - SCC, and Miscellaneous Revenues.

Local Revenue Sources

Local revenues considered in this analysis come from two general sources and make up approximately 1 percent of the funds under review. The first component is urban system matching funds. The *Code of Virginia* stipulates that urban highway construction funds are to be distributed on the basis of population, therefore we distributed revenues from the local match to each district on the basis of population.

The second component is the revenue-sharing program for the secondary system. In this program, each county is required to match, dollar for dollar, the Commonwealth's contribution to secondary roads projects within the county's jurisdiction. We used data provided by the Secondary Roads Division to calculate each county's relative participation in the program for each of the five fiscal years in this study. We applied these county shares to projected revenues in the VDOT budget to calculate the dollar contribution from each district.

A remaining component, the Coal Severance Tax Roads Program, which is a "pass-through" program, is not considered in this analysis.

Transportation Trust Fund Interest

VDOT receives interest on the outstanding balance in the Transportation Trust Fund each year. We distributed this interest based on the district shares of total revenues in each fiscal year.

U.S. Route 58 Corridor Development Fund

Beginning in FY 91, an economic development fund was created to finance the Route 58 corridor project. The revenue dedicated to this fund comes from the state recordation tax. The Department of Taxation provided a 5-year weighted average (fiscal years 1985-1989) of each locality's contribution to this tax. We used this information to determine each district's estimated contribution to this revenue source.

Airport Assistance

The VDOT budget (FY 92) shows that in FY 92, $9.5 million was transferred from the general fund to develop an airport assistance fund to upgrade facilities at Dulles International Airport. We distributed this revenue geographically to the districts on a per capita basis.

Appendix C

Geographic Distribution of Revenues
Supporting VDOT Activities

GEOGRAPHIC DISTRIBUTION OF REVENUES SUPPORTING VDOT ACTIVITIES

We have created a general model to estimate the geographic distribution of revenues used to support VDOT's four major activities. By examining the VDOT budget and the legislatively mandated allocation process, we estimate the relative shares of TTF and HMOF funds used for each activity. These shares generally match the activity classification of allocation programs we detailed in the report. A key assumption underlying this model is that the geographic distribution of revenues *within* the TTF and the HMOF is homogeneous. In other words, we assumed that a particular revenue source, such as sales and use tax revenue, does not simply pass through the HMOF before being allocated directly to a particular program, such as the regulation of outdoor advertising. All revenues are assumed to lose their "individual identity" once they enter the HMOF or TTF. The distribution of revenue in both the HMOF and TTF were estimated based on the methodology of Appendix B and are shown in Tables C-1 and C-2. It should be noted that districts' shares of HMOF and TTF funds differ because different combinations of revenue sources are used in each fund.

In the following sections, we will describe the details of our general model for each of the four activities. Figures C-1, C-2, and C-3, which illustrate the flow of transportation resources through the HMOF and the TTF, will be used to clarify our modeling approach.

Table C-1
Geographic Distribution of the HMOF, FY 88 - FY 92

	1988	1989	Fiscal 1990	Year 1991	1992	5-yr Avg.
Bristol	7.23%	7.28%	7.32%	7.46%	7.49%	7.36%
Culpeper	5.65%	5.76%	5.85%	5.90%	5.89%	5.81%
Fredericksburg	6.10%	6.25%	6.39%	6.48%	6.49%	6.34%
Lynchburg	6.71%	6.75%	6.76%	6.76%	6.78%	6.75%
Northern Virginia	19.12%	19.00%	19.53%	19.16%	19.07%	19.18%
Richmond	16.02%	15.92%	15.94%	15.96%	15.98%	15.96%
Salem	10.81%	10.78%	10.37%	10.92%	10.68%	10.71%
Staunton	8.79%	8.77%	8.80%	8.87%	8.89%	8.82%
Suffolk	19.58%	19.49%	19.04%	18.49%	18.73%	19.07%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Derived from VDOT budgets, FY 88-FY 92

Table C-2
Geographic Distribution of the TTF, FY 88 - FY 92

	1988	1989	Fiscal 1990	Year 1991	1992	5-yr Avg.
Bristol	5.59%	5.17%	5.32%	5.24%	5.18%	5.30%
Culpeper	4.80%	4.54%	4.65%	4.62%	4.59%	4.64%
Fredericksburg	4.96%	4.72%	4.85%	4.79%	4.77%	4.82%
Lynchburg	5.72%	5.29%	5.38%	5.29%	5.26%	5.39%
Northern Virginia	24.72%	26.57%	27.33%	27.86%	28.03%	26.90%
Richmond	16.48%	16.65%	16.57%	16.49%	16.45%	16.53%
Salem	9.69%	9.29%	9.14%	9.29%	9.11%	9.30%
Staunton	7.24%	6.95%	7.04%	6.90%	6.87%	7.00%
Suffolk	20.79%	20.82%	19.72%	19.52%	19.74%	20.12%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Derived from VDOT budgets, FY 88-FY 92.
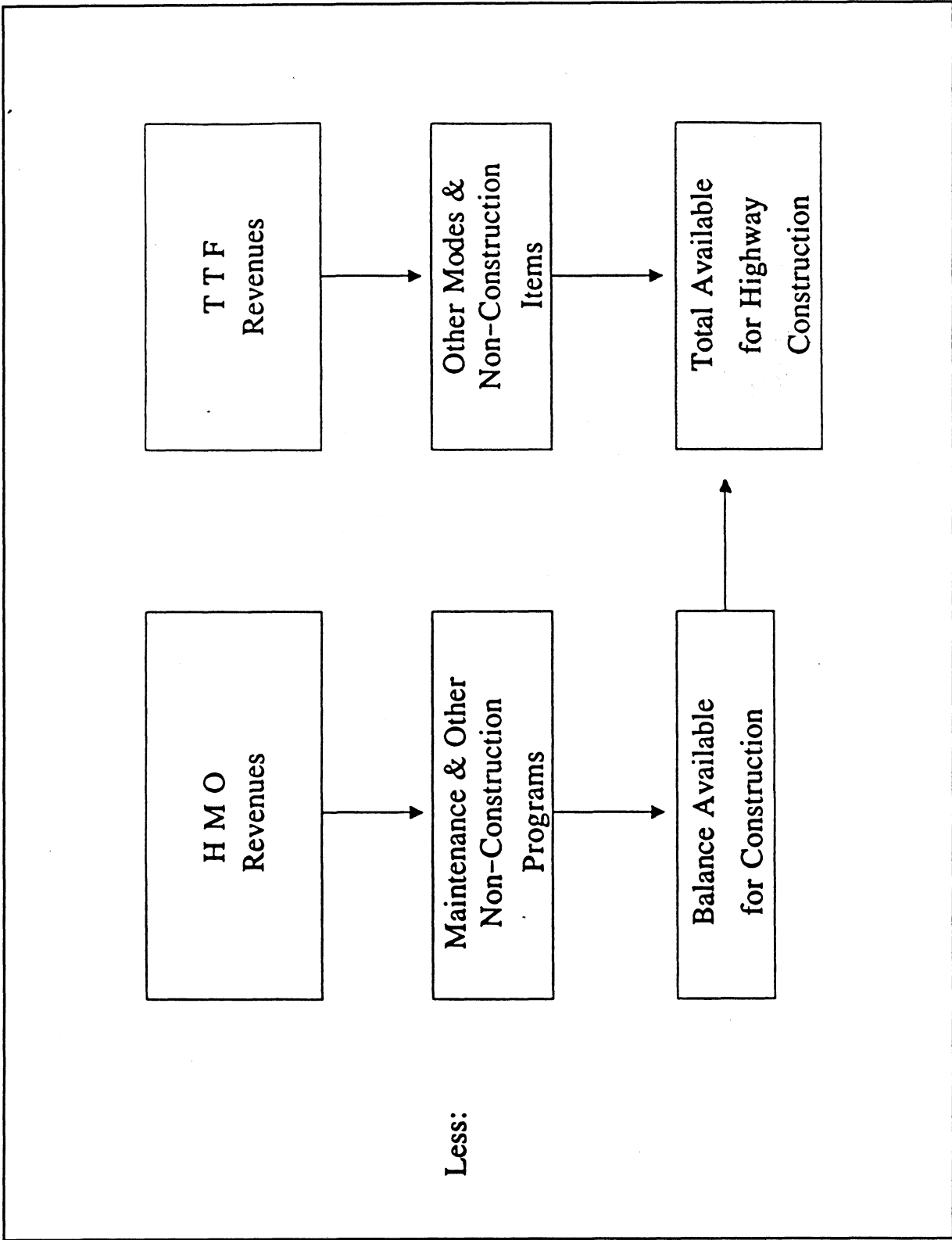
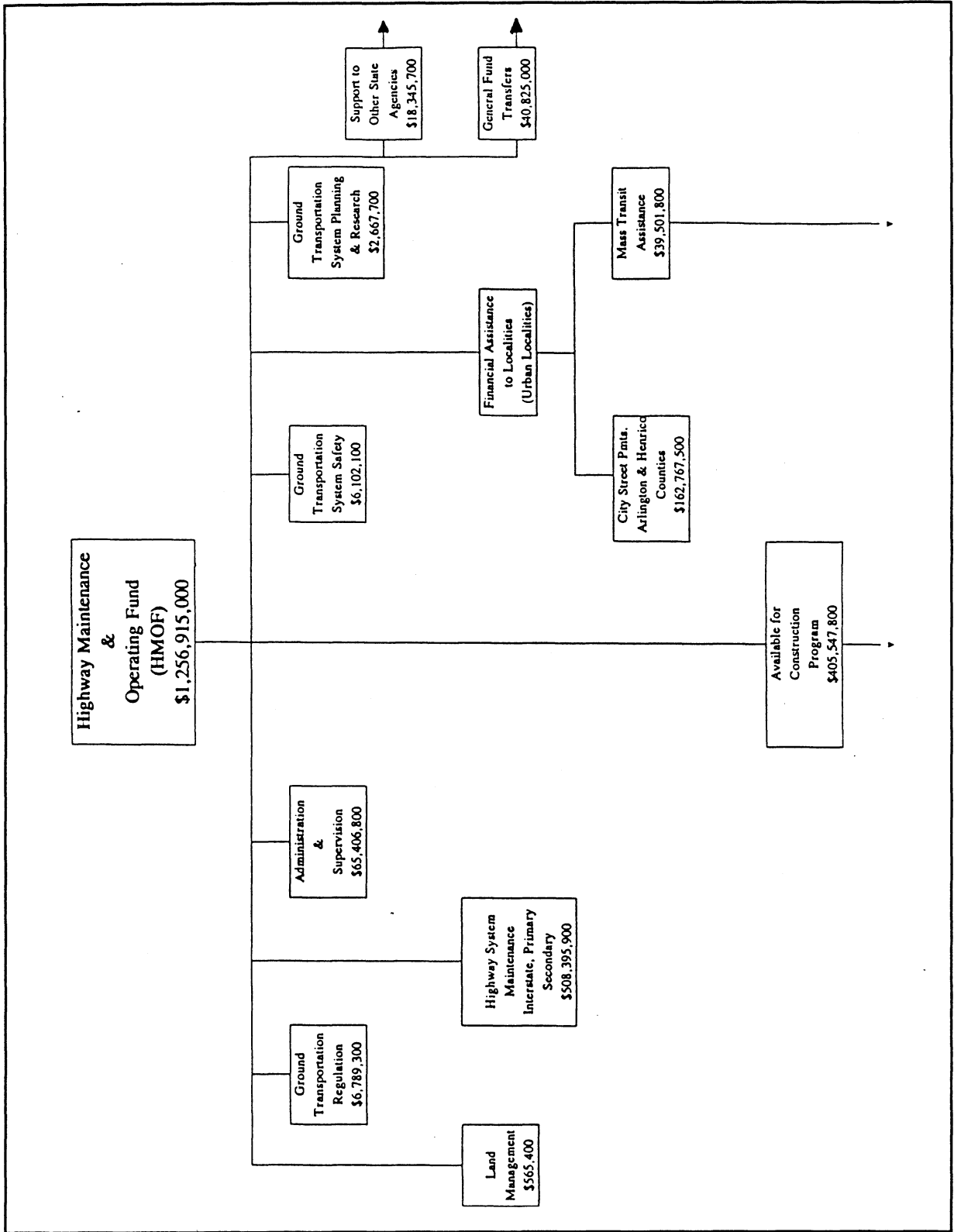Figure C-1. Commonwealth Transportation Funds.

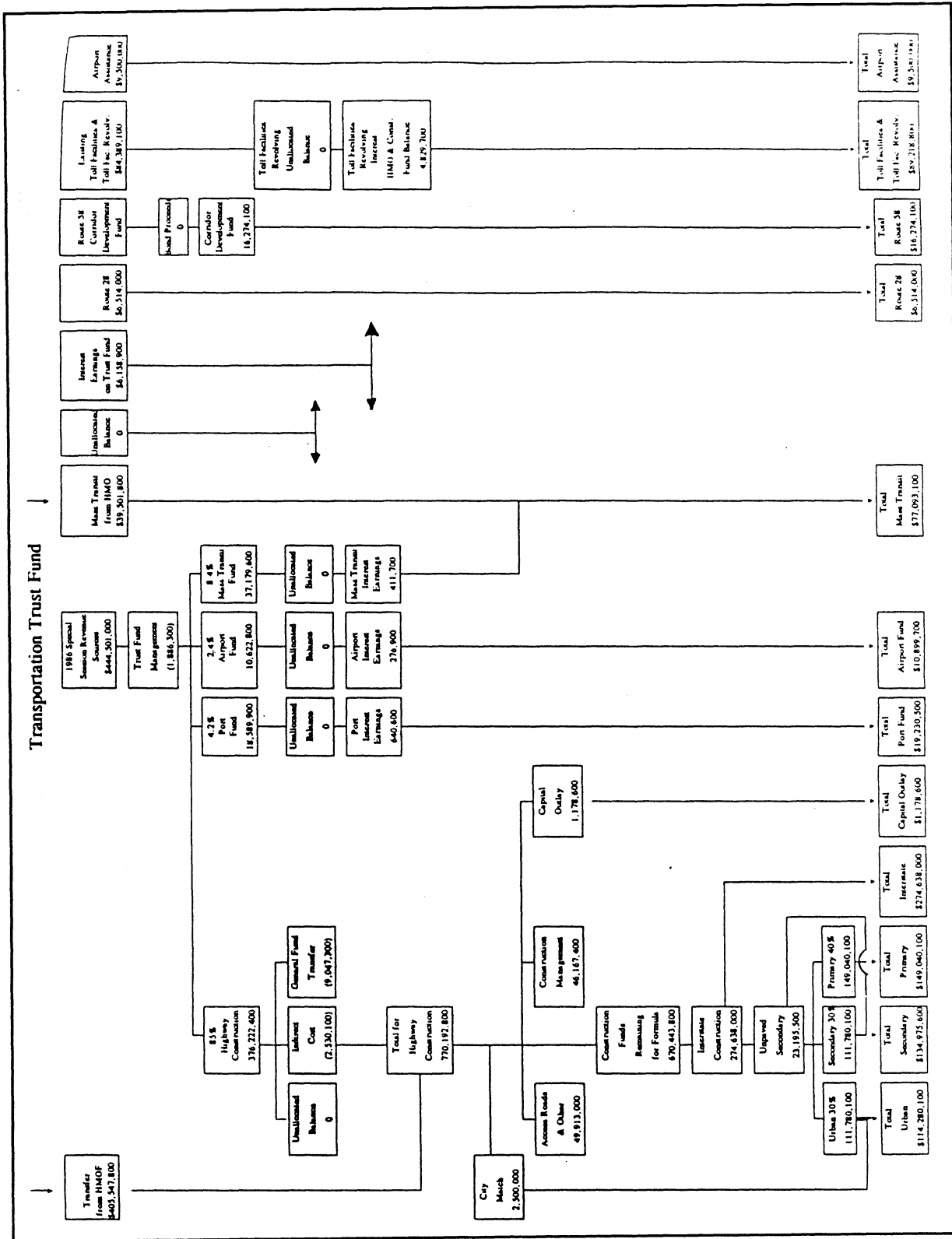Figure C-2. Highway Maintenance and Operating Fund, FY 92.

The diagram boxes contain:

Highway Maintenance & Operating Fund (HMOF) $1,256,915,000

Support to Other State Agencies $18,345,700

General Fund Transfers $40,825,000

Ground Transportation System Planning & Research $2,667,700

Ground Transportation System Safety $6,102,100

Financial Assistance to Localities (Urban Localities)

Mass Transit Assistance $39,501,800

City Street Pmts. Arlington & Henrico Counties $162,767,500

Administration & Supervision $65,406,800

Highway System Maintenance Interstate, Primary Secondary $508,395,900

Available for Construction Program $405,547,800

Ground Transportation Regulation $6,789,300

Land Management $565,400

Figure C-3. Transportation Trust Fund, FY 92.

Maintenance Activity

Figure C-2 illustrates that VDOT's maintenance activities (composed largely of Highway System Maintenance: Interstate, Primary, Secondary, City Street Payments, and Ground Transportation System Safety) are funded from HMOF revenues. For this reason, we use the geographic distribution of HMOF revenues shown in Table C-1 to represent the revenue shares supporting the maintenance activity.

Construction Activity

Figure C-3 shows that VDOT's construction activity is funded jointly by HMOF and TTF revenues. For example, in FY 92, $405,547,800 was transferred from the HMOF to the TTF for construction. In addition, $364,645,000 (reduced from $376,222,400 by a FY 92 General Fund transfer and indirect costs) of TTF funds were dedicated to the construction activity. Therefore, our general model assumes that 52.7 percent of the construction activity is funded by the HMOF and 47.3 percent is funded by the TTF in FY 92. We combined these weights (HMOF: 52.7 percent and TTF: 47.3 percent) with each district's share of TTF and HMOF revenues (from Tables C-1 and C-2) to derive the revenue shares that support the construction activity. The general model for this process is detailed below.

$$CONSTR_{D_d}^t = CONSTR_{HMOF}^t \times (HMOF_{D_d}^t) + CONSTR_{TTF}^t \times (TTF_{D_d}^t),$$

where

$CONSTR_{D_d}^t$ = share of construction activity revenue for D_d in year t,

$CONSTR_{HMOF}^t$ = HMOF share of construction activity revenue in year t,

$CONSTR_{TTF}^t$ = TTF share of construction activity revenue in year t,

$HMOF_{D_d}^t$ = share of HMOF revenues for D_d in year t,

$TTF_{D_d}^t$ = share of TTF revenues for D_d in year t,

D_d = 9 VDOT construction districts,
t = FY88–FY92.

Table C-3 displays the HMOF and TTF weights for the construction program from FY 88-FY 92. These weights are substituted in the construction activity revenue formula for the appropriate year.

Table C-3
HMOF and TTF Share of Construction Activity Revenue

FY	HMOF Share	TTF Share
1988	49.3%	50.7%
1989	62.2%	37.8%
1990	51.1%	48.9%
1991	53.4%	46.6%
1992	52.7%	47.3%

Source: Derived from VDOT budgets, FY 88-FY 92

Administration Activity

Figure C-2 shows that the majority of the programs that comprise VDOT's administration activity receive their funds directly through the HMOF. These programs include Land Management, Ground Transportation Regulation, Administration & Supervision, Ground Transportation System Planning & Research, and Support to Other State Agencies. As with the maintenance activity, we used the geographic distribution of HMOF revenues (see Table C-1) to represent the revenue shares supporting the administration activity.

Nonhighway Activity (Mass Transit, Ports, and Airports)

Revenues from the TTF are used to support the Port Fund, the Airport Fund, and the Mass Transit Fund (see Figure C-3). In addition, Figure C-2 shows that the Mass Transit program in Virginia is partially funded by the HMOF. Therefore, since the nonhighway activity is supported by revenues from both the HMOF and the TTF, we will estimate the HMOF and TTF weights using the methodology we developed to estimate weights for the construction activity. Table C-4 shows the HMOF and TTF weights for the nonhighway activity. We combined these weights with each district's shares of HMOF and TTF revenues (from Tables C-1 and C-2) to derive the revenue shares that support the nonhighway activity. The model is similar to the construction model, and its notation is as follows:

$$NONHWY_{D_d}^t = NONHWY_{HMOF}^t \times (HMOF_{D_d}^t) + NONHWY_{TTF}^t \times (TTF_{D_d}^t),$$

where

$NONHWY_{D_d}^t$ = share of nonhighway activity revenue for D_d in year t,

$NONHWY_{HMOF}^t$ = HMOF share of nonhighway activity revenue in year t,

$NONHWY_{TTF}^t$ = TTF share of nonhighway activity revenue in year t,

$HMOF_{D_d}^t$ = share of HMOF revenues for D_d in year t,

$TTF_{D_d}^t$ = share of TTF revenues for D_d in year t,

D_d = 9 VDOT construction districts,
t = FY88-FY92.

Table C-4
HMOF and TTF Share of Nonhighway Activity Revenue

FY	HMOF Share	TTF Share
1988	38.7%	61.3%
1989	39.4%	60.6%
1990	35.8%	64.2%
1991	37.1%	62.9%
1992	36.8%	63.2%

Source: Derived from VDOT budgets, FY 88-FY 92.