EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES

OVERVIEW

by

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16. Abstract This study focused on the effects of Federal funding policies and structures of transportation investment. Several recent policy developments in highways, airports, and transit were analyzed toward this end. Procedurally, the work progressed by performing six discrete transportation analyses and then drawing together insights gained from these to suggest basic funding principles. These principles were then investigated through interviews on the 1978 Surface Transportation Act with 21 transportation professionals. Our overall recommendations were then advanced in light of the interview feedback. This report is structured with each of the discrete analyses available separately as follows:

Appendix A, Mass
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

page

Acknowledgements iv

Summary and Recommendations vi

Summary vi

Recommendations ix

I. A Perspective on the Study 1

A. Focus 1

B. Approach 6

C. Structure of the Report 9

D. Other Sources of Project-Related Information 10

II. Toward an Understanding of Transportation Funding Structures and Policies 12

A. Background 12

B. Program Intent 13

C. The Level of Federal Aid 15

D. Matching Ratio 19

1. Matching Ratio - "Within Program Comparisons" 19
2. Matching Ratio - "Stimulation or Substitution" 22
3. Matching Ratio - "Across Programs Comparison" 29

E. Formula Versus Discretionary Allocation 33

F. Categorical Versus Block Grants 36

G. Open- Versus Closed-endedness 43

H. Further Issues: Fiscal Scarcity and Equity 44

III. Perspectives: The 1978 Surface Transportation Act 50

A. Background 50

page

B. Interview Results 52

1. Easing of Transfers Among Highway Programs 52
2. Increase in Federal Matching Share for Funds Transferred from the Interstate Program 53
3. Increase in Federal Share for ABCD and Appalachian Highways 54
4. Provisions to Accelerate Completion of the Interstate System 56
5. Changes in the Bridge Replacement Program 57
6. Transit Program Changes 59
7. The 3R Programs and the Issue of Federal Support for Maintenance 60

C. Synthesis 60

1. Level and Matching Ratio 61
2. Formula Versus Discretionary Grants 63
3. Categorical Versus Block Grants 64
4. Open- Versus Closed-endedness 65

IV. Conclusions and Critical Issues 68

Appendices

A. Effects of Federal Transportation Funding Policies and Structures: Mass Transit

B. Effects of Federal Transportation Funding Policies and Structures: Highway Matching Requirements and Funding Levels, A Preliminary Model of State Response

C. Effects of Federal Transportation Funding Policies and Structures: Statistical Analysis of the Impact of Federal Aid on State Allocative Decisions

D. Effects of Federal Transportation Funding Policies and Structures: The Appalachian Development Highway System

E. Effects of Federal Transportation Funding Policies and Structures: Analysis of State Highway Projects by Federal Aid System and Type of Work

F. Effects of Federal Transportation Funding Policies and Structures: The Airport Development Aid Program: Implications of a Changing Federal-Aid Program

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Naturally, we take responsibility for interpretations made and any mistaken conclusions drawn.

Summary and Recommendations

Summary

This study focused on the effects of federal funding policies and structures on transportation investment. Several recent policy developments in highways, airports, and transit were analyzed toward this end.

Procedurally, the work progressed by performing six discrete transportation analyses and then drawing together insights gained from these to suggest basic funding principles. These principles were then investigated through interviews on the 1978 Surface Transportation Act with 21 transportation professionals (plus less formal consideration of possible 1980 Airport legislation - see the Airport analysis). Our overall recommendations were then advanced in light of the interview feedback.

This report is structured with each of the discrete analyses available separately, and the underlying philosophy presented as an overview report. As the overview report is not merely a summary of the appendices, a brief synopsis of each of these is included here.

A. Mass Transit: Statistical analysis of Urban Mass Transportation Administration (UMTA) financial assistance projects from 1965-1977 notes increasing transit needs (especially for operating expenses), an increasing federal role, and the key differentiation between rail and bus activities (with rail concentrated in some seven cities, but representing 70% of current capital obligations). The distribution of UMTA funds per transit commuter is found to be quite uniform. Large cities are determined to be more responsive to federal aid opportunities, but the increase in matching share to 80% in fiscal 1974 appears to have stimulated broader participation. The states are seen as providing increasing transit assistance to localities, but we could not document state influence on the distribution of federal funds. An intriguing comparative situation involving four possible sources of federal aid for a community considering a capital improvement suggested logical preference for available discretionary funds over one's formula allocation, subtle differences due to matching ratio, and little danger to the highway program from transfers to transit. Considerations of the funding structures and of the proposed 1978 legislation (not passed at the time of the analysis) conclude the piece.

B. Highway Matching Requirements and Funding Levels, A Preliminary Model of State Response: This study first describes the patterns of federal and state highway expenditures from 1950 through 1975. Interesting findings include a trend of decreasing federal and state levels of support for highways (in constant dollars), increasing emphasis on the ABCD (Primary, Secondary, Urban Extensions, and Urban System) highways relative to the Interstate, and a trend toward increasing maintenance expenditures. Significant dispersion among the states is demonstrated on such measures as user tax rates and per capita tax burden. Four different measures of state highway needs are explored. An attempt to model the response of states to the increased federal matching share for fiscal 1974 postulated that some states act as "builders" (construction in excess of matching requirements), while others tend to be "matchers." It proved difficult to predict state responses to the policy change on the basis of needs and fiscal capabilities.

C. Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions: The focus here is on the relationship between changesin federal aid funding structures and expenditure patterns of the 48 states over the time period 1957-1975. Regression analysis findings include the observation that each dollar per capita of federal aid was associated with an increase in states' own capital expeditures by about 7 to 8 cents for both the Interstate and ABC programs. This implies that states invest at near the required matching share on the Interstate, but at a much lower level on the ABC (e.g., at a 50% matching share, a federal dollar nominally requires a dollar of state funds). Analysis of subsets of the states found striking variations, indicating that federal matching share is not a dominant factor in state allocation decisions. Various contextual factors, especially the extent to which a federal program matches perceived state needs, appear very important.

D. The Appalachian Development Highway System (ADHS): This multi-billion dollar categorical aid program established in 1965 is assessed. A comparative analysis emphasizes five core Appalachian states (of the thirteen total) in contrast to nine states similar in highway and socio-economic character, but without ADHS activity. Results indicate stimulation of overall state highway efforts, with relatively minor shifts in level of effort on other highway programs. Regression and time series analysis complement each other, with particularly interesting interpretations of an apparent increase in state outlays to make up for decreasing, constant dollar, federal ABC Systems aid levels. The effects of a sizable federal matching share differential are seen to be outweighed by state interests. In general, the ADHS appears to be contributing to regional development as a viable categorical aid program.

E. Analysis of State Highway Projects by Federal Aid System and Type of Work: This project level analysis looks at changes in funding patterns over time on the federal aid systems. It shows a dramatic shift in emphasis during the 1970's from building new roads to improvement of existing roads. Miles of new roads built annually have declined by 64 percent between 1960 and 1977 while road improvements have increased by 98 percent. As an exception to the national trend, new road construction continues at a high pace in the Appalachian states, attributable to a stimulative effect of the Appalachian Development Highway System. Roads on the Primary and Urban Systems and bridges are receiving greater attention (in comparison with the high point of the highway construction era in 1965) at some expense to the Interstate and Secondary roads. Capital investment has not kept up with inflation. Indications are that federal funds will increasingly become a dominant factor in capital investment decisions. Road preservation and bridge improvement are programs of growing importance, yet the federal role here seems to be financial relief in that the states had already shifted emphasis in these directions in the 1970's.

F. The Airport Development Aid Program: Implications of a Changing Federal Aid Program: Basic statistical descriptions of this program from its begininning in FY71 through FY77 are offered. These show a growing level of federal investment accompanied by decreasing local investment. The major uses of the funds are for land acquisition and construction site preparation at existing airports, but a notable increase in safety and environmentally motivated outlays takes place. Comparisons among the different size airport hub categories as federal matching provisions changed for some in FY74, and again in FY76, failed to show definitive effects of matching ratio on investments. We found ADAP investment levels per passenger enplaned to be considerably higher at smaller airports, raising the issue of who should subsidze them, and how much. Consideration of funding intent in the choice of funding structures leads to some comments on the proposed 1980 legislation.

Overview Report: The overview report first puts forth the implications of manipulations of matching ratios, allocation mechanisms, and categorial restrictions on federal aid programs. Recommendations regarding the specification of these funding structures are cast as a function of funding intent (which is distinct from such general objectives as increased mobility and decreased auto usage). It is clear that in attempting to assess the implications of federal policies one must consider program intents. The ultimate test of funding structures is in measuring the extent to which they further these intents and objectives. The four intent categories used here are:

1. Compelling national interest in the program per se.
2. Regional development.
3. Aim of motivating the recipient to expend more of his own funds on the program.
4. Provision of financial relief on this program to the recipient.

Particular funding parameter specifications are given in the Recommendations section of this summary.

Secondly, the overview paper reports on interviews with transportation professionals. The following are some of the perceived effects of the 1978 Surface Transportation Act as regards funding parameters:

- ABCD and ADHS program increases in matching ratio will result in an overall decrease in program sizes. (However, fiscally stripped states, such as Pennsylvania, should increase their program size.) An indirect effect may be the subsequent requesting of increased federal fund levels.
- The transit shift of routine, capital needs (buses) to a formula program is expected to aid in administration and planning.
- The bridge program provision of some discretionary funding is also seen as helpful.
- The appropriateness of federal funding of non-federal-aid bridges (through a categorial program in particular) is questioned.
- The increased number of subcategories in transit should reduce recipient flexibility and is therefore also questioned.

Suggestions for future legislation include the easing of categorial restrictions by using more block grants and also the easing of transfers between categorical programs. Future critical issues in the transportation arena which must be addressed include the inflation drain on revenues and the growing role of maintenance and operations. Three other problems are also very notable: energy saving, rail revival, and enhancement of mobility.

Recommendations

The specification of recommendations for transportation funding parameters requires clearly defined national policies and delineated intergovernmental funding roles. Therefore, the scope of the recommendations here must include the proper context for our specific funding parameter suggestions:

1. The establishment of national, intermodal transportation policies, priorities, and plans is essential. These must be developed consonant with energy, environmental, and urban concerns. All levels of government should be involved.
2. The funding roles of the federal, state, and al governments should then be defined in light of the national policies, priorities, and plans. Clear distinctions should be made between those programs that serve compelling national funding intents and those that do not.
3. Only when the first two recommendations have been effected can sensible funding parameter policies be successfully implemented. These policies should take the following form:
   a) with respect to the setting of matching ratios and program levels:
      - if the federal funding intent is to provide fiscal relief to the states or localities, then the matching ratio should be relatively high so as to decrease leverage on, and provide associated flexibility to, recipients.
      - if the federal funding intent is to provide a program of national interest, then the federal match should again be relatively high (as, by definition, the program is national).
      - if the federal funding intent is "stimulation" of a region, then the matching ratio should be set with respect to market conditions to assure the desired effect.
      - note that the notion of a particular program's "stimulation" at the expense of other recipient program expenditures is

discouraged here. The approach advocated is the setting of agreed-upon priorities and attempting to meet those.

- the funding level should be that necessary to maintain each program's priority ranking.

b) with respect to the determining of allocation type (either formula or discretionary):

- formula allocations should in general be specified due to their more assured nature and easier administration, except when large portions of recipients' budgets must be spent on single projects. In this case sufficient flexibility (e.g., through multi-year carry-over provisions, transfer authority, or discretionary funding) should be provided to fund these projects.

c) with respect to the specifying of programs as categorical or block:

- if the funding intent is national interest, then a categorical grant should be specified to insure that the national priority is met.
- if the funding intent is fiscal relief, then block grants should be used to allow recipients maximal discretion in meeting local needs.
- in either case, program restrictions should be minimized if possible

d) with respect to the closed-or-open-endedness of a program:

- if a program is of national interest, then sufficient closed-endedness of a program should be specified at its inception to guarantee that the national interest is fulfilled. If the funding intent of the program changes over the life of the program, then open-endedness should be considered.

This study has focused on the specification of desirable transportation funding parameters. Over the course of this work, however, we have become convinced that it is of the utmost importance to relate funding parameter specifications to the intent of the aid program. Hence, we suggest that implementation of all three recommendations together is necessary to rationalize transportation funding structures and policies.

I. A Perspective on the Study

A. Focus

It seems most important for the reader to understand what we have, and what we have not, addressed. The federal role in transportation is obviously an issue of immense scope. Figure 1 portrays a portion of this complex system. Highlighted in the figure are the "federal funding structures." As noted therein, and defined in Table 1, these include matching share (or ratio), allocation mechanism - formula or discretionary, and whether a grant program is categorical or block in nature. We have emphasized study of these structures and their effects in the context of highway, transit, and airport aid programs. We have also considered whether a program is closed- or open-ended in scope or time.

Most significantly, we have found (to no one's surprise) that we had to address other facets of the system if we were to comprehend the implications of the funding structures. Parallel to the funding structures in Figure 1, we have noted the level of federal aid as obviously important to any program. In some cases, level interacts importantly with funding structures in influencing the behavior of a program. State and local financial decisions have been of prime interest as immediately affected by funding structures and policies. We have tried to understand how these will change as a result of changes in matching ratio, formula vs. discretionary character, and categorical or block nature of federal aid programs.

We learned quite a lot during the course of the research (we think). One of the striking indications of this is the contrast in our view of federal program funding intents vis-à-vis evaluation of the effects of funding structures. Readers familiar with our July 1978, draft, Phase I report may recall our emphasis on the "stimulation" vs. "substitution" implications of funding structures. As reflected in Figure 1 and Table 2,

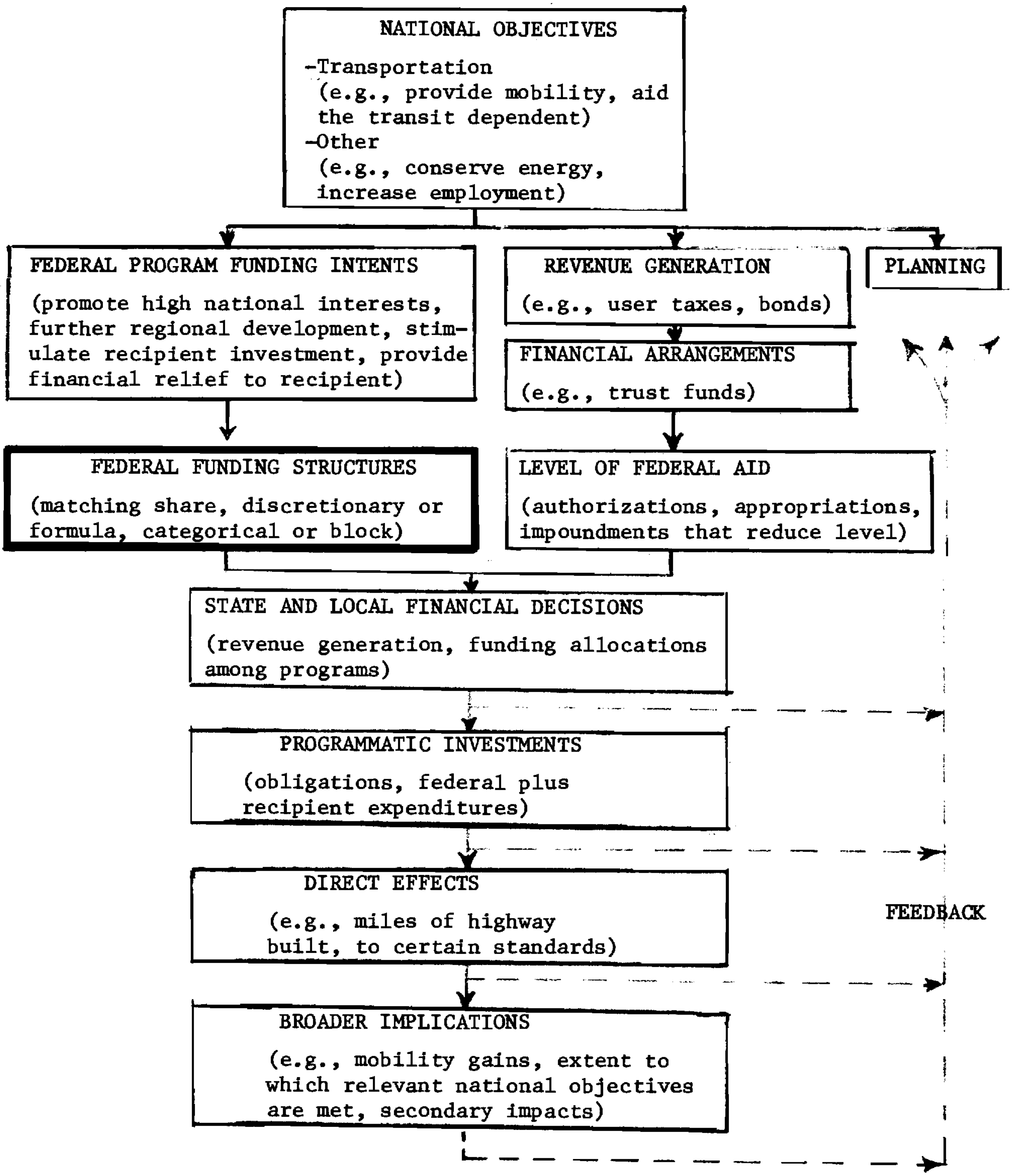

Figure 1. The Role of Federal Funding Structures in the Transportation System

Table 1. Some Definitions

Federal Matching Ratio - That percentage of the program effort which the federal government will pay until its appropriation limit is reached. (Beyond that limit, recipients must pay 100%.)

Program Matching Ratio (g) - The required amount of recipient plus federal money required for every dollar of federal money (i.e., $g \geq 1$).

Program Effect - The total (recipient plus federal) program amount which must be expended if the state is to capture all federal funds, expressed as a fraction of what the total program amount was last year.

Formula Programs - Funds are apportioned among the recipients on a prescribed basis, e.g., population density.

Discretionary Programs - Funds must be applied for on a project-by-project basis, and they are not set aside for each recipient.

Block Grant - A grant given chiefly to general purpose governmental units in accordance with a statutory formula - intended for use, largely at the recipients' discretion, in a variety of activities within a broad functional area.[a]

Categorical Grant - A grant which can be used only for a specifically aided program and usually limited to narrowly defined activities.[a]

Closed-ended Program - A program that has federal commitment of funds limited to some prescribed amount, location, and/or time (e.g., the Interstate highway system on route location and system completion date).

Open-ended Program - A program that does not have a specified limit to federal involvement in certain respects (e.g., the "ABCD" highway system is not generally limited in route location or completion date).

[a] Advisory Commission on Intergovernmental Relations, A Catalog of Federal Grant-in-Aid Programs to State and Local Governments: Grants Funded FY1975, Washington, D.C., 1977.

Table 2. Transportation Capital Programs Classified by Program Intent

TRANSPORTATION CAPITAL PROGRAM	Program Funding Intent	Packaging		
	1. High National Interest 2. Regional Development 3. Motivate Recipient to Expend More of His Own Funds on This Program 4. Provide Financial Relief on This Program to Recipient (Support)	Matching Ratio (Federal Share)[a]	Type of Allocation F = Formula D = Discretionary	Type of Grant C = Essentially Categorical B = Essentially Block
<u>HIGHWAYS</u>				
1. Interstate				
- mid 50's to early 70's	1	90%[b]	F	C
- mid 70's to present	4	90%	F	C
2. Federal aid primary, secondary, urban extension, urban system (ABCD)				
- "early" (20's, 30's & 40's)	3	50%	F	C
- "later" (50's to present)	4	75%[c]	F	B
3. Appalachian Development Highway System (ADHS)	2	80%	F	C
4. Bridges	4	80%	F, also some D	C
<u>URBAN MASS TRANSIT</u>				
5. UMTA Section 3	4	80%	D	C
6. UMTA Section 5	4	80%	F	B
7. Transfers from Hwys. (Urban System/Interstate)	4	75%/85%	"D"	≈ B
<u>AIRPORTS</u>				
8. Airport Development Aid Program (ADAP)				
- Air Carrier	1	{See Figure 4}	F/D	C
- General Aviation	4		F/D	C

[a]The percentages, unless otherwise indicated, are as of 1-1-79. Also, the percentage is somewhat higher to the Public Land States in highway and airport programs.
[b]50% from 1952-54; 60% from 1954-56.
[c]50% until FY1974; 70% until FY1979.

our view has changed to now consider four basic funding intents (as distinct from general objectives; see Figure 1):

1. Compelling national interest in the program per se.

2. Regional development.

3. Aim of motivating the recipient to expend more of his own funds on the program (≈ stimulation, but see Section II).

4. Provision of financial relief on this program to the recipient (support).

We did not infer "stimulation" (Intent 3) as currently a dominant aim for any of the eight major aid programs studied (Table 2). Reflecting this alteration in our perception, some of our policy recommendations are changed from the preliminary analysis.[1]

To reiterate then, our focus is on federal funding structures, with a heavy emphasis on their relationships with program funding intents and state and local financial decisions. In the course of analyzing these facets of the system, we necessarily address programmatic investment levels (Figure 1) and consider levels of federal aid. We have not generally tried to go beyond these fiscal matters to consider direct physical effects and the broader implications in substantive detail. Nor have we gone back to ponder national objectives in any depth. Again, we have not addressed the issues attendant to revenue generation and financial arrangements (e.g., trust funds), other than as issues arising in the discourse on funding

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[1] A fifth funding intent has been suggested, namely the provision of a suitable mechanism by which users can aid in financing the development of desired programs (e.g., as with the Highway Trust Fund). However, this revenue-generating intent is different from our other four intents, which are more program-focused. Furthermore, there is no à priori theoretical reason to assume that such trust funds could not be established on other than a national basis, or that the funds raised could not be directly returned to states or localities without any programmatic or categorical restrictions. Thus, we omit this fifth intent.

structures. Since performance of the transportation system depends on many related features (e.g., technical standards associated with federal aid programs, related regulations, and planning), we do not attempt to "evaluate" the effects of federal funding in a total sense. Furthermore, we recognize that the system is not simple and linear. Feedback of information, both technical and political in nature, is very important. Political factors are likely to be vitally important to the determination of funding policies; hence, we recognize the inherent limitations in any technical analysis. We have attempted to at least consider such factors in making suggestions.

B. Approach

In general, this study draws on statistical analyses complemented by insights gained through interviews with a number of transportation officials. The research process was iterative--initial hypotheses were refined through literature review and preliminary interviews; basic statistical analyses were performed; and further interviews and more refined analyses were conducted.

In particular, a limited set of examples was selected to provide useful evidence of the implications of key structural funding parameters. These examples include the introduction of the Interstate system program and the Appalachian Regional Commission's (ARC) highway programs; changes in the funding provisions for the "ABCD" highway programs[1] occurring in fiscal year 1974; changes in mass transit funding provisions for fiscal year 1974; and Airport Development Aid Program shifts in fiscal 1974 and

[1] "ABCD" programs are the Federal-Aid Primary (A), Federal-Aid Secondary (B), Urban Extensions of the Primary and Secondary (C), and the recently created (1972) Urban System (D).

1977. The useful contrasts arising from the special treatment given in federal programs to both Appalachian and Public Land states (i.e., those with substantial areas of national forests and nontaxable Indian lands) are also exploited. For example, in the case of the Public Land states, the non-Public Land states are the (obvious) contrast. (Table 4 provides one example of the different treatment given the two groups.) With respect to the Appalachian states, a comparison group had to be contrived. First a core group of five Appalachian states was defined; then a comparison group of nine states (chosen on similarity of size, urbanization, state highway capital investment characteristics, and socio-political behavior patterns) was formed. (See Figure 2 and Appendix D for details.)

The data base on which the statistical analyses were drawn covers the time span from roughly 1950 to 1975 for the 48 contiguous states. Over 200 variables are included, spanning programmatic, economic, political, technical, social, organizational, and physical characteristics. It also includes files on Urban Mass Transportation Administration (UMTA) grants, selected socioeconomic characteristics of urbanized areas, Federal Highway Administration (FHWA) projects, and Airport Development Aid Program projects. For highways, both expenditure and obligation data are in-hand; for transit and airports, only obligation data are generally available.[1]

Due to a recognition of the highly complex nature of the transportation funding process, the quantitative (data base) work was buttressed by

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[1]Legislation <u>authorizes</u> funding; a separate <u>appropriations</u> bill makes this available during a given fiscal year. In the Appalachian program, the ARC <u>allocates</u> these appropriations to the states (resulting in their <u>entitlements</u>). An <u>obligational ceiling</u> is the maximum amount of funds a state can commit in a fiscal year. <u>Obligated</u> funds are those actually approved to be expended for specific work. Lastly, actual <u>outlays</u> or <u>expenditures</u> result to pay for that work. (Based on Appalachian Regional Commission, <u>Highway Policy Issues</u> Report, Washington, D.C., June 1974, pp. 11-21.

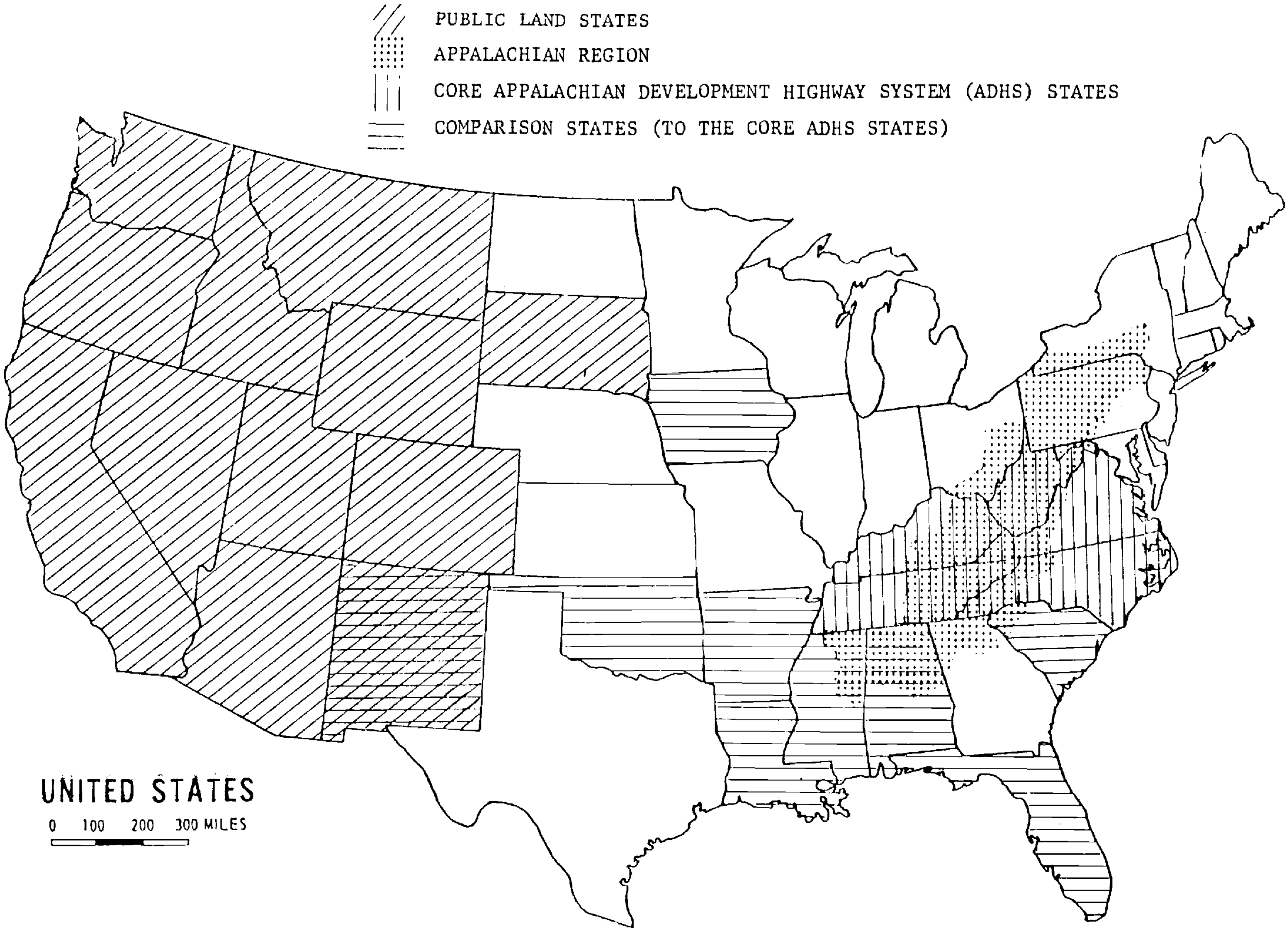

Figure 2. Groups of States for Analytical Purposes

conversations with transportation experts. One particularly important aspect of this phase of the study was obtaining the views of 21 transportation professionals of diverse backgrounds (see Acknowledgements). The professionals commented on general funding policies, the 1978 Surface Transportation Act (STA), and future transportation funding issues. We then tried to draw these perspectives together with our understanding of federal funding structures developed from the analytical efforts.

C. Structure of the Report

We believe that this study can prove useful in two distinct ways. First, we hope we have promoted careful analysis of various attributes of the system of federal aid for transportation. Section II sets forth conceptual points and substantive conclusions worthy of further analytic attention. Second, we offer a number of pointed recommendations which we hope will have practical value. These recommendations basically relate to the manipulation of funding structures toward fulfilling various intents. We do not address the merits of the intents themselves. For instance, recommendations typically have the flavor of "if the intent is such, then . . ."

The total report is structured as follows.

1. Section II presents a distillation of the principal lessons learned from the conduct of the discrete analyses presented as Appendices. It does not summarize those analyses, but rather puts forth our understanding of the implications of manipulations of matching ratio, allocation mechanism (formula vs. discretionary), and categorical restrictions (vs. block grants) of federal aid programs. Specific recommendations are derived.

2. Section III presents transportation professionals' perceptions of the Surface Transportation Assistance Act of 1978. A synthesis of these views with the analysis of Section II follows.

3. Section IV formulates conclusions and delineates future critical issues likely to exacerbate the present situation.

4. The Appendices contain the individual technical analyses that underlie the interpretations of Section II. These are intended to stand alone, and each leads to conclusions in its own right. Synopses are provided in the preceding Summary section.

D. Other Sources of Project-Related Information

Several other sources of project-related information should be noted. Choon Y. Park prepared a Master's Thesis entitled "Analysis of the Appalachian Development Highway Program as a Policy Intervention."[1] This formed the basis for Appendix D. It provides in-depth treatment of the analytical considerations in the quasi-experimental "non-equivalent control group design," upon which conclusions were based. The approach may be of interest to others attempting to weigh the effects of a policy intervention when a comparison group not directly affected by the policy change exists. Loren P. Rees is presently working on a Ph.D. Dissertation entitled "Statistical Methods for Public Policy Analysis." The thrust of this effort is to investigate the use of statistical analyses to inform the policy process. An in-depth examination of the transportation funding literature (as well as a survey of other policy areas) will lead into development of techniques perceived to offer special promise for useful application. We have also endeavored to disseminate our findings in the open literature and through participation in conferences, as follows.

Porter, A. L. The Role of Information in Perpetuating Urban Highway Dominance Over Transit. Urban Systems, 3, 211-221, 1979.

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[1] Park, C. Y., Analysis of the Appalachian Development Highway Program as a Policy Intervention, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA, August 1978.

Porter, A. L., Rees, L. P., Rao, S., Larson, T. D., and Park, C. Y. Transportation Funding Structures and Policies. Submitted to Transportation Research.

Park, C. Y., and Porter, A. L. Effects of the Appalachian Development Highway Program: A Quasi-Experimental Analysis. Submitted to Growth and Change.

Park, C. Y., Porter, A. L., and Connolly, T. Implications of the Airport Development Aid Program (ADAP). To be submitted to Traffic Quarterly.

Porter, A. L. Transit Funding: Implications of Federal Aid Strategies. To be submitted to Transportation.

Porter, A. L., Rao, S., and Larson, T. D. Effects of Federal Funding Policies on State and Local Transportation Performance: Preliminary Findings. Transportation Research Board Annual Meeting, Washington, D.C., January, 1978.

Porter, A. L., Rao, S., Larson, T. D., Park, C. Y., and Rees, L. P. Effects of Federal Transportation Funding Policies and Structures. Transportation Research Board Annual Meeting, Washington, D.C., January, 1979.

Porter, A. L. Federal Transportation Funding Policies: Five Recommendations. TIMS International Meeting, Honolulu, June, 1979.

Park, C. Y., and Porter, A. L. Economic Impacts of Federal Transportation Policy on Regional Development: The Case of the Appalachian Development Highway System. TIMS International Meeting, Honolulu, June, 1979.

II. Toward an Understanding of Transportation Funding Structures and Policies[1]

A. Background

Recent experience and current concerns point to the importance of a careful consideration of federal funding parameters for transportation aid programs. Increases (and decreases) in federal shares in the airport development program, provision of federal aid for operating expenses of urban transit authorities, the proliferation of federal aid highway programs, and stresses placed on highway funding sources by shortfalls in state revenues since the oil embargo of 1973 illustrate the dimensions of the issues involved. Recently enacted legislation has changed highway and transit matching provisions, provided more flexible highway-transit fund interchange, increased the use of formula program funding in transit, and placed critical deadlines for eligibility of Interstate projects. These issues all relate to federal funding policies and structures. (Terms are defined in Table 1.) The intent of this section is to assess implications of such policies and structures.

Federal support of state and local transportation efforts has been a primary means of pursuing the broad national objective of "good" and "low cost" transportation. Various funding structures have been used in this context. One effort that can assist the formulation of future federal funding policies is an analysis of how past policies have affected state and local transportation investments. In practice, the cause-

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1. This section is closely based on a manuscript entitled "Transportation Funding Structures and Policies" by Alan L. Porter, Loren P. Rees, Srikanth Rao, Thomas D. Larson, and Choon Y. Park, submitted to Transportation Research. That, in turn, was based on the first phase project draft report.

effect relationships are extremely difficult to determine because of limitations in available data and the presence of complex, confounding factors. Nonetheless, helpful insights can be gained with regard to such questions as:

(1) How do recipients respond to the spectrum of matching ratios offered by competing programs?

(2) What happens to total program area effort when the federal matching share is increased?

(3) When should programs be structured as categorical? Which programs should be packaged as less restrictive block grants?

(4) What differences arise from using an apportionment formula rather than awarding discretionary grants?

B. Program Intent

By intent we do not refer to such transportation objectives as increased mobility and decreasing auto usage. Rather we refer to the reason for federal involvement in a program. For instance, is the intent of this funding to stimulate a region of the country economically, or is it to aid some states who are strapped for funds to maintain their programs?

Determining the intent of the different federal aid programs is a difficult undertaking, as previous attempts demonstrate. One study classified the purpose of grants according to a "support, stimulate, or demonstrate" scheme.[1] The Advisory Commission on Intergovernmental Relations - ACIR - found this trichotomy inadequate[2] and subsequently classified

1. Subcommittee on Intergovernmental Relations, "Federal Programs of Grants-In-Aid to State and Local Governments," U.S. Congress, Senate, 91st Congress, 1st Session, Committee Print, 1969.

2. Advisory Commission on Intergovernmental Relations, Categorical Grants: Their Role and Design, Washington, D.C., 1977.

442 grants according to six purposes "to arrive at a roughly accurate profile of Congressional intent or emphasis." These purposes are support, stimulative, capacity building, training, complementary grants, and national programs.

With a spirit of caution, we set forth our view of intent for eight transportation programs. We specify four different categories of federal intent (leaning heavily on the ACIR concepts), ranging from the pursuit of highly national purposes to provision of financial relief to a recipient (Table 2). The terms "stimulate" and "substitute" roughly correspond to intents 3 and 4, respectively. Note that no program is currently classified under intent 3, although an argument could be made that programs such as transit stimulate as well as support.[1] For instance, we have included transit programs as intent 4 rather than intent 1 because it is difficult for us to picture a particular locality's transit needs as of national importance; however, as the energy crisis escalates, transit intent may well change to intent 1.

Not only is the transit intent dynamic, a case may be made for other modes as well. Perhaps the ABC program has progressed and the Interstate program will progress through time from programs of national interest (intent 1) to motivational inducement (intent 3) to programs providing financial support (intent 4). On the other hand transit programs may proceed from intent 4 to intent 1. In any event, however, the point to be emphasized here is that funding intent is a dynamic factor; hence, program aid structures should be expected to vary over time.

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[1]Advisory Commission on Intergovernmental Relations, A Catalog of Federal Grant-in-Aid Programs to State and Local Governments: Grants Funded FY1975, Washington, D.C., 1977.

Federal aid packages seem to come in an inexhaustible number of sizes and shapes; the only common element seems to be the strings attached. Nonetheless, we have tried to unwrap aid packages along five dimensions: level of aid, matching ratio, formula versus discretionary allocation, categorical versus block restrictions, and closed versus open-endedness. We discuss each dimension in turn, attempting when possible to "partial out" the effects of the other dimensions.

C. The Level of Federal Aid

We briefly illustrate the obvious importance of the amount of federal aid. The highest level of federal aid to transportation historically has been to highways, although mass transit programs increased in volume in the 1970's. The level of aid to many transportation programs increases over time; it appears that once federal aid has begun, it may be "counted on" to increase. As an example, the average federal highway expenditures over time are shown in Figure 3. However, when inflation is considered, it is seen that the constant dollar expenditures have been decreasing over the last 10 or 15 years (Figure 4). Also, highway costs are escalating at a rate greater than the consumer price index (Figure 5). Thus federal aid is increasing but is meeting less and less of the real costs. From the state perspective, these factors, plus increasing traffic volume, deteriorating highway systems, and increased vehicle fuel efficiency, are causing severe revenue problems. As Cooper observes,[1] states are turning to novel approaches to re-establish revenue growth.

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[1] Thomas W. Cooper, The State Highway Finance Outlook, U.S. Department of Transportation, Federal Highway Administration, Office of Program and Policy Planning, December 1978.

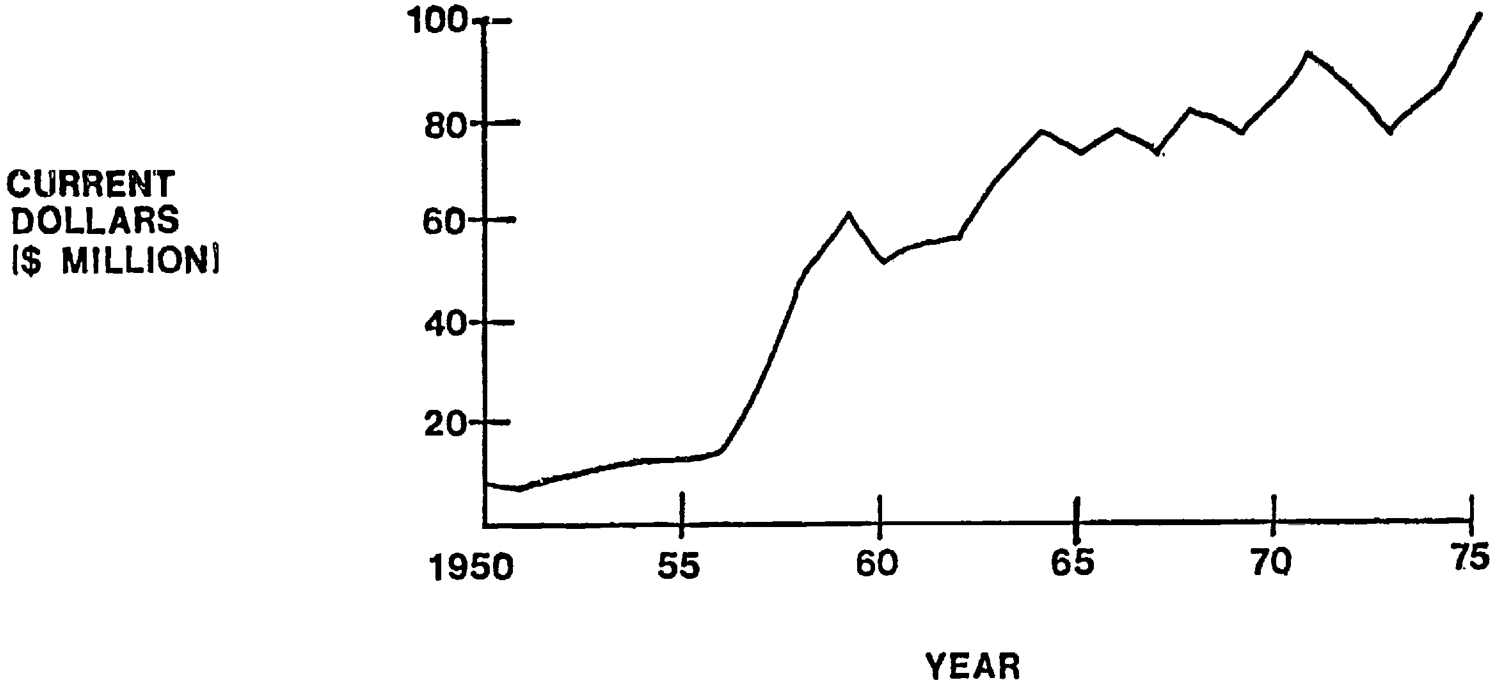

FIGURE 3: AVERAGE CURRENT-DOLLAR FEDERAL HIGHWAY EXPENDITURES PER STATE

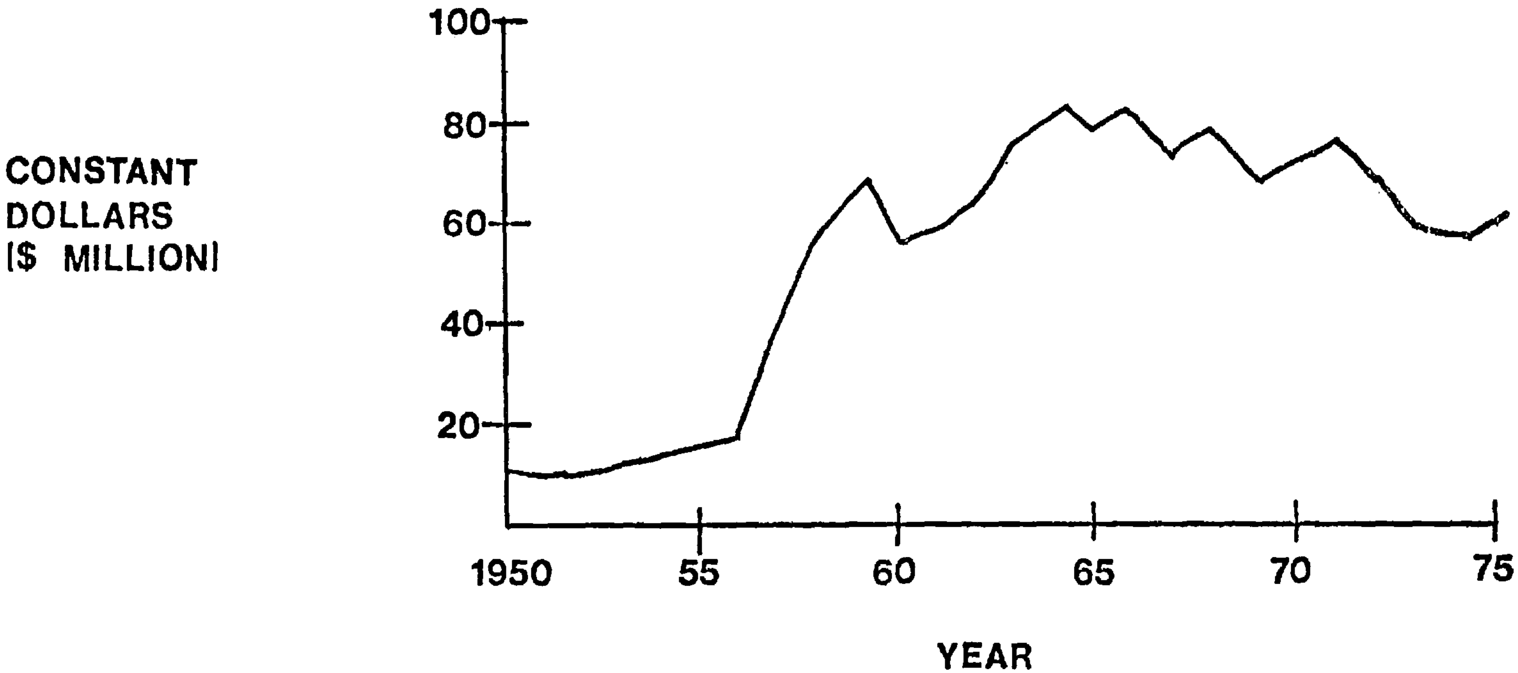

FIGURE 4: AVERAGE CONSTANT-DOLLAR FEDERAL HIGHWAY EXPENDITURES PER STATE

(1967 BASE CONSUMER PRICE INDEX)

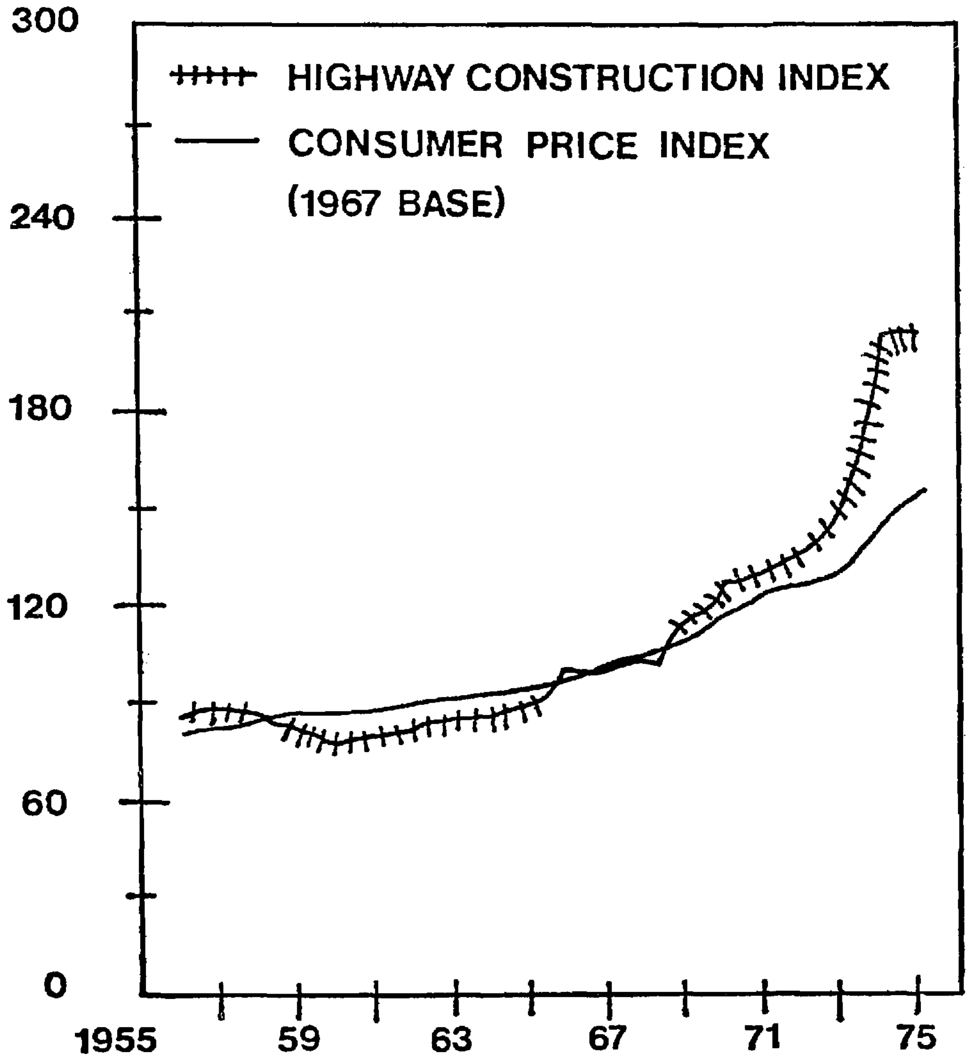

FIGURE 5: COMPARISON OF THE HIGHWAY CONSTRUCTION AND CONSUMER PRICE INDICES

D. Matching Ratio

1. Matching Ratio - "Within Program Comparisons"

Potential recipients face a variety of program matching ratios and the choices among them are complex, to say the least. Therefore we first attempt to examine recipient response to matching ratio on an individual program basis, then proceed to an across-programs analysis. Within the individual program subsection, we first provide an example. We follow that with a discussion of matching ratio as a function of intent and then of level. Finally, we consider matching ratio in terms of "stimulation" and "substitution."

A beautiful example of matching ratios changing over time and their effect is provided in the airport sector. Air carrier airports are classified as large, medium, small, or non-hubs (based on enplanements). The Airport Development Aid Program (ADAP) has reflected changed matching ratios for various sized hubs in fiscal years 1974, 1976, and 1979, as shown in Table 3. The corresponding expenditure effects are also shown in the same table. We see that, in this case, an increase in matching ratio is associated with an increase in federal support level and usually total program effort - but not sponsor funds! We ask, therefore, how, in general, may the federal government expect recipients to respond to matching ratio changes? And at what level should matching ratios be set?

Philosophically, the level of the matching ratio should be a function of program intent. Intent 1 of Table 2 would be expected to have a high federal matching ratio (quite close to 1.00) as the programs are national in nature. Intents 2 and 3 both entail attempted motivation (either of a region generally or a recipient programmatically), and as such must be sufficiently high to be fiscally attractive. The level of

Table 3. Airport Development Aid Program: Funds and Matching Shares

Airport Category[a] (Number)		Fiscal Year Period[b] 1971-73	74-75	76-77
Large Hubs (20)	Federal Matching Share[c]	50%	50%	75%
	Federal Aid Funds/enplanement[d]	0.57	0.60	0.79
	Sponsor Funds/enplanement[d]	0.60	0.60	0.36
	Total Funds/enplanement[d]	1.17	1.20	1.15
Medium Hubs (30)	Federal Matching Share	50%	75%	75%
	Federal Aid Funds/enplanement	1.07	1.43	1.94
	Sponsor Funds/enplanement	0.95	0.45	0.64
	Total Funds/enplanement	2.02	1.88	2.58
Small Hubs (71)	Federal Matching Share	50%	75%	90%
	Federal Aid Funds/enplanement	1.28	2.29	4.30
	Sponsor Funds/enplanement	1.12	0.74	0.60
	Total Funds/enplanement	2.40	3.03	4.90

[a] These are the airports that consistently fit the three categories, over the time period considered (excluding airports that changed categories; and airports that themselves fit a lower category, but were owned by a larger sponsor and hence were considered larger for federal aid during the first two periods). Large hubs are those air carrier airports that enplane 1% or more of the nation's passengers in a given year; medium hubs, those from 0.25% to 0.99%; and small hubs, those from 0.05% to 0.24%. In addition there are non-hub air carrier airports, reliever airports, and general aviation airports.

[b] These periods correspond to changes in federal aid provisions. No federal aid was released in fiscal year (FY) 76 until the transition quarter.

[c] The figures represent general capital improvement aid shares. Certain airports (especially those in Public Land states) were eligible for higher federal aid shares. Certain project categories were eligible for higher federal shares as well, including landing aids, certain navigation aids, and required equipment. Provisions for FY 78 were the same as for FY 76-77. However, for FY 79-80, the federal share for small hubs has been reduced to 80%.

[d] Figures are dollars/enplanement/year. Total dollars to all of the included airports in a hub category were divided by total enplanements in a typical year (estimated for the FY 76-77 period), divided by the years in each period. The first period was 3 years; the second, 2 years; the third, 2 years (no aid released during FY 76 until the transition quarter). Similar tabulations, yielding the same pattern, were made using dollars/enplanement/year calculated for each airport, then averaged for the hub category.

attractiveness is a function of other federal program ratios and current economic conditions, to mention only two parameters. The size of the matching ratio under intent 4, the provision of financial relief, would be expected to be high. This may be lowered if there is a mutual desire to leverage a decision-making body (e.g., a state legislature) into advancing more funds for the program in question.

One must be careful not to infer program effort from the matching ratio; for example, an inexperienced observer might think that the higher the matching ratio, the higher the program level is likely to be. That this is not the case, we demonstrate in the following hypothetical example:

--at a 50 percent match, \$63 federal aid requires \$63 state outlay, for a total effort of at least --\$126.

--at a 70 percent federal share, \$63 federal aid requires \$27 state outlay, for a total effort of at least --\$ 90.

--at a 90 percent federal share, \$63 federal aid requires \$7 state outlay, for a total effort of at least --\$ 70.

If the total effort is unlikely to greatly exceed the minimum required to use up all federal aid, then, compared to a 50 percent match, a 70 percent federal share will yield 29 percent less total effort; a 90 percent federal share will yield 44 percent less total effort. Or, to obtain the same level of total effort from a 90 percent program as from a 50 percent program would require a 79 percent increase in federal aid level (\$113 of federal aid to generate \$126 total effort)!

The same type of situation occurs when there is a change in matching ratio. Just because the matching ratio increased does not imply that the program size should have increased. Again the change is intimately tied to level. Consider the following argument. (First note that, traditionally, states do not forego federal monies.) Program effect is defined as the total (state + federal) program amount which must be expended if the state is to capture all federal funds, expressed as a fraction of what the total program amount was last year. For example, if this year's program must be \$20 million to get all federal money, and last year's was \$10 million, then the program effect is 2.0. Note that the program effect may be less than, equal to, or greater than unity. Now consider, as an example, the fiscal 1974 change in matching ratio from 50% to 70% for the ABCD program. Table 4 shows the program effect which resulted from the matching ratio and level changes. Note that most program effects are less than 1.0. This type of result would be potentially disastrous for a program with intent 2 or 3, but may be fine for a type 4 intent. In any event, the point is that an increase in matching ratio does not necessarily effect (or even encourage) an increase in program size.

2. Matching Ratio - "Stimulation or Substitution"

The issue of "substitution" and "stimulation" is often brought up in the literature in connection with matching ratios. Although we do not favor policy-makers thinking in such terms as "maximizing stimulation" without regard to program intent, we examine the concepts, using Gramlich's (1969) terminology to add precision to our discussion.

Let E represent expenditures on the program (federal + recipient), G be the size of the matching grant, and g be the legal matching ratio, where here we define the ratio as the required amount of recipient plus federal money required for every dollar of federal money (i.e., $g > 1$). Figure 6 plots the ratio of marginal expenditures to marginal grants, yielding important definitions.

Substitution is hereby defined to be that range for which $\frac{\partial E}{\partial G}$ is between 0 and 1, for in this range an increase in grant is spent in such

Table 4. ABCD "Program Effect" of the 1973 Federal Aid Highway Act Changes

State	Pre-Change Matching Ratio	Post-Change Matching Ratio	Post-Change "Program Effect"
Public Land States			
NV	.90	.94	1.06
AZ	.77	.86	.87
UT	.76	.86	1.02
WY	.66	.80	.73
NM	.64	.79	.75
OR	.64	.78	.87
ID	.63	.78	.70
CA	.59	.76	.95
CO	.57	.74	.73
MT	.57	.74	1.02
SD	.55	.73	.76
WA	.53	.72	.35
MEDIAN	.635	.78	.815
Non-Public Land States			
AL	.50	.70	.45
AR	.50	.70	.64
CT	.50	.70	.50
DE	.50	.70	.49
FL	.50	.70	.42
GA	.50	.70	.58
IL	.50	.70	1.12
IN	.50	.70	.49
IA	.50	.70	.37
KS	.50	.70	.86
KY	.50	.70	.48
LA	.50	.70	.28
ME	.50	.70	.98
MD	.50	.70	.27
MA	.50	.70	.75
MI	.50	.70	.86
MN	.50	.70	.66
MS	.50	.70	.35
MO	.50	.70	.48
NE	.50	.70	.90
NH	.50	.70	.28
NJ	.50	.70	.45
NY	.50	.70	.44
NC	.50	.70	.81
ND	.50	.70	.68
OH	.50	.70	.60
OK	.50	.70	.55
PA	.50	.70	.33
RI	.50	.70	1.04
SC	.50	.70	.38
TN	.50	.70	.51
TX	.50	.70	?
VT	.50	.70	.48
VA	.50	.70	.12
WV	.50	.70	.15
WI	.50	.70	4.11
MEDIAN	.50	.70	.49

Note: In computing the "program effect," expenditure data were used and a one-and-a-half year time lag was assumed between the appropriation and its expenditure (i.e., to evaluate the "post-change" program effect, federal aid was assumed to be the 1975 calendar year (CY) expenditure, and the last-year program level was assumed to be the CY 1974 federal + state expenditure).

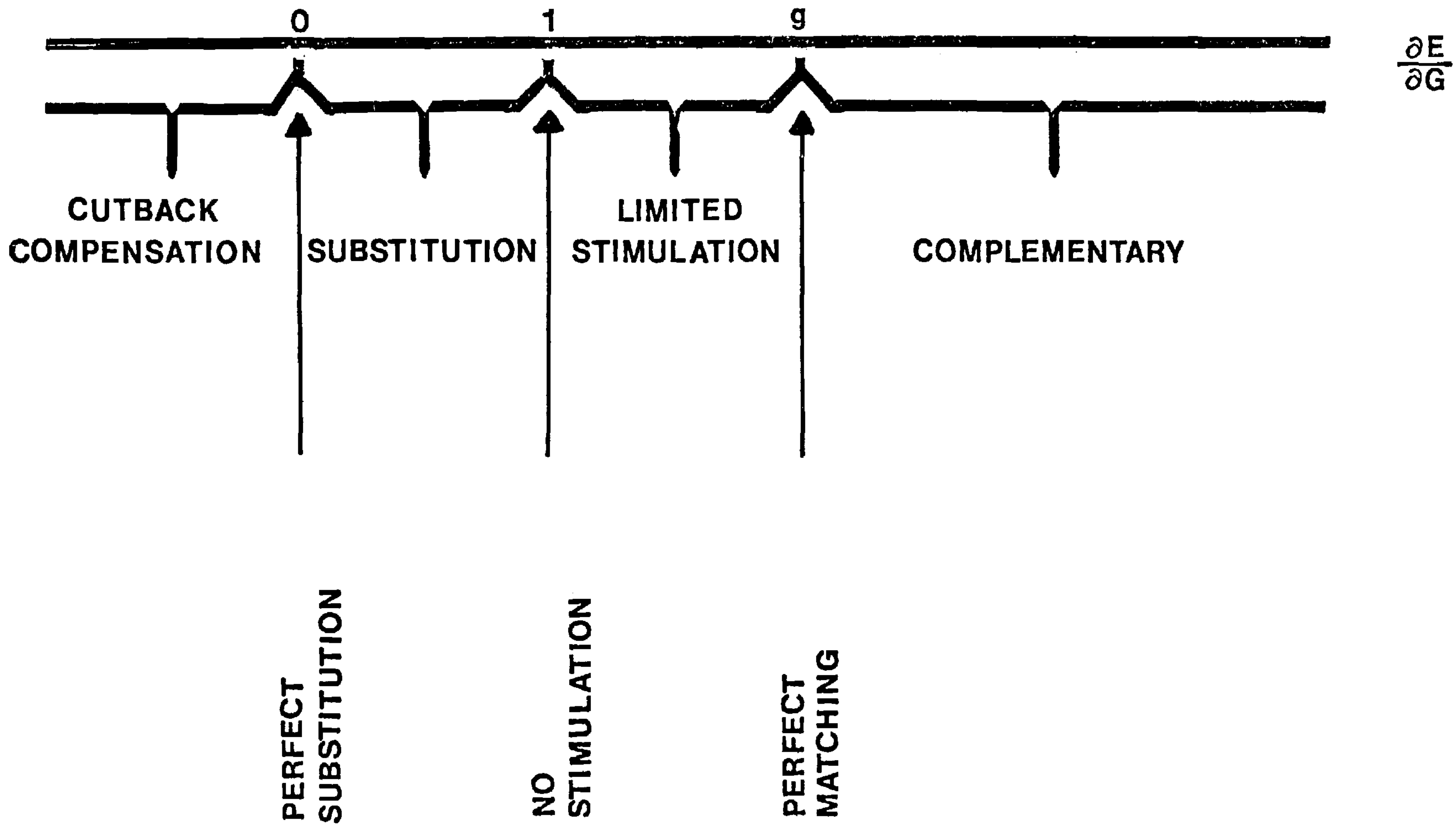

FIGURE 6: STIMULATION AND SUBSTITUTION

a way that not only does the program size not increase, but another program gets some of the grant money (or the citizens get a tax break). The limited stimulation range is that region for which $\frac{\partial E}{\partial G}$ is between 1 and g; here all federal money and some recipient money is spent on the program. The complementary range is that part of the axis for which $\frac{\partial E}{\partial G}$ exceeds g, for in this case the federal money is complementing an otherwise ambitious non-federal program. And finally we add the cutback compensation region to Gramlich's definitions as that negative portion of the axis which represents increased recipient expenditures in the face of federal cutbacks [e.g., as occurred with the decline in real dollar federal "ABC" support in the late 1960's; see Porter and Park (Appendix D)].

In the highway arena, Rao (Appendix C) has demonstrated that for the Interstate system over the years 1957-70, $\frac{\widehat{\partial E}}{\partial G} \approx g$. This is a case of perfect matching and is not logically inconsistent with the national purpose of the program. On the other hand, he found that for the same time period the ABC program has fit the limited stimulation situation, with $\frac{\widehat{\partial E}}{\partial G} \approx 1.07 < 2 \approx g$. This too is not at variance with the federal intent of fiscal relief. At no recent time, to our knowledge, was the intent of the ABC program to aggressively stimulate state spending.

Of interest is the Appalachian Development Highway System (ADHS) program. Porter and Park (Appendix D) report that this program acts in the complementary range. Besides effectively "overmatching" on the program itself, five "core" ADHS states (KY, NC, TN, VA, WV) appear to have increased not only the total capital outlay (state and federal funds), but also state-only (exclusive of federal aid) highway outlays. There has been a widening gap between the ADHS states and the comparison group from essentially equal capital outlays on all roads (1955-1959) to about 65 percent greater outlay in 1972. Perhaps, the most striking evidence of the stimulation of the highway effort in the five core ADHS states is the increase in their bonded indebtedness and gas tax rates relative to the comparison states. The ADHS program is thus associated with a general boost in the state highway effort, in line with the intent of regional development through increasing highway mobility. (This does not demonstrate that the ADHS program was the only cause of this increase, but it is obviously contributory. The establishment of the ARC involved the states in the first place, so it would be improper to assume that the enhanced state highway effort was just a response to the federal aid program.) Observations by ARC and Federal Highway Administration personnel support the premise that the level of construction activity would decline in the absence of the ADHS program.[1]

High federal matching shares are politically popular, and recent and proposed policy changes tend to increase the federal portion for airports, transit, and highways. There is evidence that increasing the federal share can broaden participation in programs. For instance, the increase in the federal matching share from a flexible 66.67% to a mandatory 80% in fiscal year 1974 for the UMTA Section 3 (discretionary grant) and Section 9 (technical assistance) programs broadened participation in terms of the size of participating urbanized areas. As indicated in Figure 7, fiscal years 1974 and 1975 show a relative increase in the percentage of smaller cities receiving grants. The same holds true for proportionate number of grants received, and proportionate total and average grant amounts.

However, high federal shares may distort recipient priorities and

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1. Appalachian Regional Commission, Highway Policy Issues Report, Washington, D.C., 1974, p. 31.

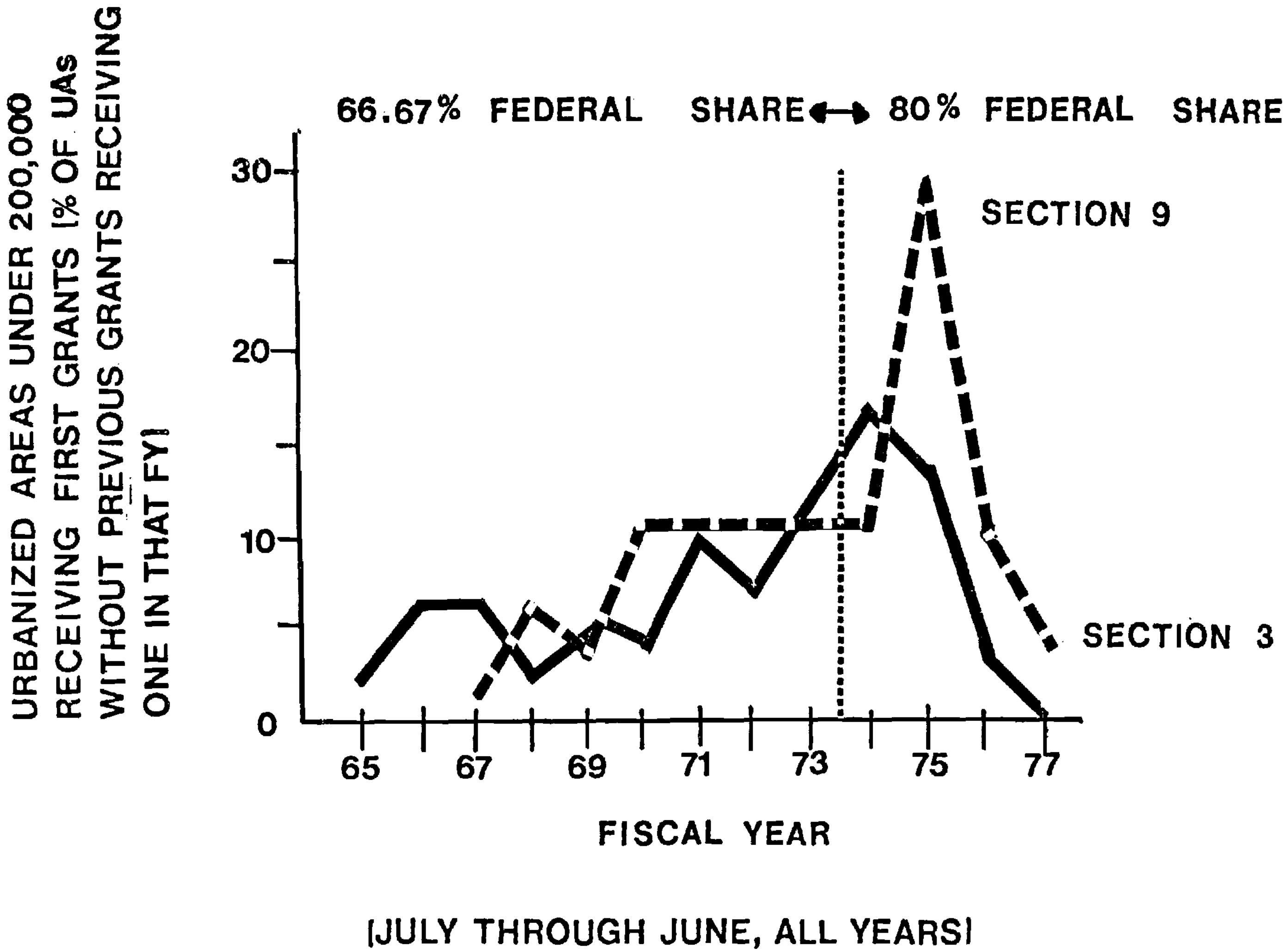

FIGURE 7: FIRST GRANTS TO URBANIZED AREAS UNDER 200,000

induce less economic investments. For instance, what community would not "need" the economic benefits associated with constructing an airport, or whatever, at 5¢ on the $1.00 (i.e., where a state contributes half of the non-federal match when general aviation airports received 90% federal support). This is not to say that foolish investments will necessarily be induced (for "need" must often be demonstrated, particularly in the case of discretionary projects). Rather, the implication here is that a net social cost will be incurred if priorities are obviated in the face of irresistible matching ratios. Therefore, at the very least, it seems that the federal government should not unilaterally determine high matching ratios in order to effect increased recipient investment in a program (intent 3).

We add (in passing) that once a matching ratio is set, it is difficult politically to cut back. This is the case whether one is a proponent of "winding down" a program or "beefing one up."

We now summarize our main points on individual program matching ratio analysis:

(1) The setting of the matching ratio should not be considered apart from the federal grant level and intent.

(2) An increase in matching ratio does not necessarily effect (or even encourage) an increase in program size.

(3) "Stimulation" is not a desirable, end-all goal for federal grants in the sense of "the more stimulation of recipient investment the better."

(4) High federal shares can broaden participation, but at the risk of distorting priorities.

(5) Since it is politically difficult to lower the matching ratio.

and it is sometimes desirable to raise it, federal planners should consider "low" ratios initially to limit unwanted over-commitment. However, should a consistent pattern of raising the federal share ensue, this proposal would be self-defeating as a lag in investment would be likely; overall program costs could then rise due to inflation.

3. Matching Ratio - "Across Programs Comparison"

We now proceed with an analysis of matching ratio across programs, noting that recipients are sometimes faced with many different program alternatives. Perhaps most interesting is the situation for transit capital users.

Four sources of federal aid were potentially available from fiscal 1974-1977[1] to the community interested in transit capital improvements (and minimal investment took place unless there was aid from one of these sources).

(1) UMTA Section 3 funds provided an 80% federal share, but these funds were discretionary and as such could be obtained above the formula allotment.

(2) Transferred Urban System funds gave a basic 70% federal share, but the use of these funds for transit was a substitution for their use on urban highway projects (also a 70% share).

(3) Transferred Interstate funds offered a basic 80% share, but with loss to the state of that amount of 90% federal aid.

(4) UMTA Section 5 formula funds could be used at an 80% federal

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[1]Note that this period is before the Surface Transportation Act of 1978, and hence some matching and transfer percentages may differ from those shown in Table 2.

share for capital improvements or at a 50% federal share for operating assistance.

Which did communities choose? The federal obligations from the four sources tally roughly as follows for fiscal years 1974-1977:

(1) Section 3 - 405 capital grants, for some $1,643,000,000

(2) Urban System transfers - 17 projects, for some $75,000,000

(3) Interstate transfers - 10 projects, for some $640,000,000

(4) Section 5 capital projects - 95 projects, for some $57,000,000.

The observed preference for Section 3 funds was obviously complicated by many factors (eligibility for funds, federal funding level, ease of approval, etc.). Nonetheless, two interpretations appear appropriate[1]:

(1) Communities obtained the most federal money by using allocated Urban System funds for highways (i.e., not transferring the funds for transit use) and then using other federal funds for mass transit ("competition" between a formula program and a discretionary one).

(2) More local money was usually required for a mass transit project funded through the Urban System program than through UMTA (unequal matching ratios).

The first argument seems compelling; other things being equal, a rational recipient of federal aid should request a discretionary grant instead of drawing on allotted (formula) monies that can be used for other purposes (in this case, urban highways).

The Interstate alternative has not been overly popular - some 10 projects in all: one for Philadelphia, two for Washington, D.C., and the

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[1]General Accounting Office, Why Urban Funds Were Seldom Used for Mass Transit, Washington, D.C., 1977.

rest for Boston. In terms of matching ratios, the Interstate option trades "10¢" highway dollars for "20¢" transit dollars, clearly disadvantageous from local and state perspectives.

The use of Urban System funds for transit instead of highways was less attractive to most states and their local authorities. The federal share at 80% for Sections 3 and 5 was more generous than the 70% for transferred Urban System funds. However, for ten Public Land states the higher federal Urban System share exceeded 80%. If matching share were a significant consideration, we might expect to have seen a preponderance of Urban System transfers in these ten states (although they tend to be rural states). The few instances of transfers do proportionately cluster in these ten states - about 43% of the non-rail projects for only 22% of the urbanized area population, excluding New York City. This is by no means conclusive evidence, but it is consistent with the premise that state and local officials sometimes take cognizance of small differentials in federal matching share.

Additional testimony for the importance of matching requirements comes in the form of state support and program participation by localities. For instance, Nevada provides all the matching funds for Urban System highway projects but none for mass transit projects (due to Nevada law). This is a strong inducement for a community to favor highway projects which cost them nothing directly over transit projects for which they must pay 20¢ on the dollar. Of the 23 states that had used, or planned in the next year to use, highway funds for transit projects, 15 contributed to transit capital matches.[1] In contrast, of 24 other states

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1. According to American Association of State Highway and Transportation Officials, Survey of State Aid to Urbanized Areas for Transportation, Washington, D.C., 1976.

for which information is at hand, only nine provide such aid.

While the preceding argument indicates that the matching share can make a difference in the selection of the federal aid source, especially in times of fiscal scarcity, it should be noted that the issue of a required matching share can be outweighed by other considerations. For example, the response of the Public Land states to federal highway aid is not dissimilar to that of the other states, despite their more favorable matching terms. A more striking example of the states' disregard for more favorable matching terms appears in the case of the ADHS two-lane versus four-lane choice. The Appalachian Regional Development Act authorized, and the ARC initially implemented, a 70% federal share (i.e., 30% state match requirement). In 1966, however, due to a perceived shortfall in available funds to construct the ADHS, the four-lane share was reduced to 50% (although preliminary engineering and right-of-way remained at 70%). In 1974, all ADHS construction was again authorized at 70% federal share because the ABCD system was so funded. Thus, for the main ADHS construction effort to date - August 1966 through February 1974 - there was a substantial inducement to construct two-lane instead of four-lane ADHS roads. However, the evidence indicates that the states generally ignored this matching differential and predominantly built four-lane roads, assuming higher highway taxes and capital debt in the process.

We summarize:

(1) Under conditions of fiscal scarcity, even small differentials in federal matching share can have an impact on state and local response to federal programs.

(2) However, matching ratio differentials can be outweighed by other considerations.

It is of interest to note that the Surface Transportation Assistance Act of 1978 has increased the matching ratios of several programs, notably ABC, ADHS, bridges, and transfers between programs. The current situation is depicted in Table 2. Note that from the recipients' point of view, a change from 70% to 85% is not seen as a 21% increase in federal share, but rather as a 50% decrease in their share (from 30¢ on the dollar to 15¢ per dollar).

E. Formula Versus Discretionary Allocation

The prime distinction between the formula/discretionary dimension and the categorical/block dimension (see next section), as we use the terms, is that the former entails varying degrees of latitude by the grantor agency, whereas the latter involves latitude on the recipient's part. That is, with the formula/discretionary case the grantor agency's freedom to distribute funds as it elects is the key; the degree of discretion may range from (almost) complete allocation freedom (as with project grants with no geographic requirements specified by the authorizing legislation) down to (almost) no discretionary latitude (as with allotted formula grants with the formula specified in the legislation). On the other hand, the categorical/block dimension does not deal with how the recipients get their money; it deals with how they may spend it when they get it. Thus, a strongly categorical program might specify that funds be spent only on a narrowly-defined program; block grants would allow the recipient more freedom to spend the money as wished regardless of how it was obtained.

From the recipient's viewpoint, therefore, formula funds are received on a prescribed basis (e.g., based on population and population density for UMTA Section 5, through FY78), whereas discretionary grants must be applied for on a project-by-project basis. Hence, a main advantage to formula allocations is their relatively assured nature. This eases the uncertainties of planning and can have beneficial secondary effects. For one, state and local transportation people recognize their own job security as greater in association with the reliable highway program than with the transit program. This has influenced the development of program staffs. Another advantage of formula programs is their simplified administration; it is not necessary to determine who is to receive what grant amounts.

A look at transportation programs in the light of the degree of discretion available to grantor agencies is informative. The Advisory Commission on Intergovernmental Relations (ACIR) has specified 11 different types of grants[1] along the continuum "degree of discretion exercised by grantor agency." A superposition of transportation programs along this continuum shows the following: major highway programs have traditionally occupied the least discretionary of the 11 slots; transit programs the most discretionary; and airport programs have exhibited a hybrid behavior, appearing at both ends of the range simultaneously. There has been very little activity in the middle 7 or 8 slots. However, recent transportation funding shows departures from these traditional approaches. Both the airport and transit aid programs have moved to include or increase established formula-based apportionments for recipients, while highways are venturing into discretionary programs (with the changeover of the priority primary system to a discretionary program and the funding of $200 million per year as discretionary on the bridge program).

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[1]Advisory Commission on Intergovernmental Relations, Categorical Grants: Their Role and Design, Washington, D.C., 1977, p. 110.

One may attempt to relate these shifts in discretion allowed grantor agencies to shifts in funding intents. (As our purpose here, however, is not the hard-and-fast delineation of funding intents, we proceed only at the speculative level.) An argument was made previously suggesting that the different highway programs have progressed through time from programs of national interest (intent 1) to motivational inducement (intent 3) to programs providing financial support (intent 4). On the other hand transit programs seem to be following the opposite path (due to energy problems): support to inducement to national interest. Can one therefore infer an underlying philosophy of funding national interest programs by formula grants and more supportive programs by discretionary allocations?

Although an interesting conjecture, we think the above is not (and should not be) the case. A simpler, and quite different, rationale seems to be at work here. Define R as the ratio

$$R = \frac{\text{project \$ size}}{\text{recipient annual program size}}$$

Note that a "large" R is obtained when a large portion of one's annual program must be spent on a single project. Such is the case with rail transit capital investments and airport runways, for example. On the other hand a "small" R is obtained in cases such as incremental highway improvements and the relatively small cost of bus purchases. It appears sensible to reduce red-tape by allocating the smaller R-valued projects by formula. However, one should probably only incur the extra federal attention and uncertainty concomitant with discretionary funding in the case of those projects which consume a large proportion of one's annual program size.

Although discretionary funds seem best suited to situations with "large" R's, a key concern with this type of allocation is the equitability of distribution among recipients and potential recipients. While this is always subject to debate, our analyses indicate a remarkably even distribution of UMTA Section 3 and Section 9 funds (and also Section 5) across urbanized areas on a per transit commuter basis (Table 5).

Our interviews indicate that, all things being equal, recipients prefer formula grants. But we must add that this does not preclude the use of available discretionary funds. A potential recipient may be expected to try for discretionary funds before spending his allotted funds.

In summary we observe that:

(1) Program intent relates only indirectly to type of allocation.

(2) The ratio R seems to provide sensible guidance in the choice between use of formula or discretionary allocations.

(3) Formula allocations have a relatively assured nature and are easier to administer than discretionary programs.

(4) UMTA discretionary funds, at least, appear to be rather equitably distributed (on a per transit commuter basis).

F. Categorical Versus Block Grants

As mentioned in the last section, the categorical/block dimension does not deal with how recipients get their money; it deals with how they may spend it when they get it. A strongly categorical program might imply a narrowly-defined program, whereas a block grant would allow the recipient more freedom.

The ACIR has defined a general continuum[1] showing the range of

[1] ACIR, op. cit., pp. 6-7.

Fund Category	Total (267 UAs)	Urbanized Areas by Population (Number): Over 1,000,000 (25)	500,000–1,000,000 (21)	200,000–500,000 (58)	50,000–200,000 (163)
A. Number of Projects	2512[b]	574	203	418	626
B. UMTA Funds ($ million)[a]	3850	3150	250	280	170
C. Non-Rail UMTA Funds ($ million)	2498	1805	250	274	170
D. Total Costs (UMTA + Local)/Project ($ million)[c]	4.37	13.29	2.32	2.58	0.48
E. Average UMTA Funds/UA ($ million)	14.41	126.00	11.90	4.81	1.04
F. Average Non-Rail UMTA Funds/UA ($ million)	9.36	72.19	11.90	4.73	1.04
G. Average Non-Rail UMTA Funds per Capita ($)[d]	13.22	29.86	17.21	15.21	9.45
H. Average Non-Rail UMTA Funds per Transit Commuter ($)[e, f]	2.17	1.90[f]	2.23	2.26[f]	2.17
I. Average Section 3 Non-Rail Funds per Transit Commuter ($)[e]	1.44	1.36	1.45	1.49	1.42
J. Average Section 9 Non-Rail Funds per Transit Commuter ($)[e]	0.11	0.09	0.09	0.09	0.12
K. Average Section 5 Non-Rail Capital Funds per Transit Commuter ($)[e]	0.11	0.07	0.16	0.08	0.13
L. Average Section 5 Non-Rail Operating Assistance Funds per Transit Commuter ($)[e]	0.51	0.38	0.52	0.60	0.49

[a] This analysis primarily uses an UMTA projects tape which includes 2512 projects funded through June, 1977. These total to about $5.5 billion in UMTA funds and $11.0 billion total costs. Of the $5.5 billion in UMTA funds, $3.85 billion is attributed to specific UAs (and $1.35 billion of that is for rail projects). Of these, the analyses usually focus on 762 Section 3 projects numbered 0xxx, excluding 6 numbered 7xxx (operating expenses), 5 numbered 8xxx (to UMTA itself), 7 numbered 9xxx (loans), and 1 numbered 0xxx which appeared irregular; 95 Section 5 capital projects and 494 Section 5 operating projects, excluding 1 numbered 8xxx (to UMTA itself); and 1024 Section 9 technical studies. In addition there are 76 Section 16 (elderly/handicapped) grants, 37 Section 23 grants (highway transfers - discussed in the following section of this report), and 4 Section 83 grants (Appalachian Regional Commission funds involved). Categorization as "rail" or "non-rail" reflects our judgment from UMTA tape description.

[b] 691 projects were not attributable to a specific UA, based on listed recipient and project description.

[c] This tally reflects allocation of the $11.0 billion in total costs by UA category; it does not correspond to the various breakdowns of UMTA costs which are aggregated by UAs.

[d] Computed for each UA based on 1970 population, then averaged over the UAs in a size category.

[e] Transit commuters are for each UA based on the percent in the SMSA (standard metropolitan statistical area) who used public transportation to work during census week, 1970, multiplied by the UA population, and by 52 weeks/year. The ratios are computed for each UA, then averaged over the UAs in a size category. Data on transit commuters was missing for 24 cities who received UMTA funding; 23 in the smallest size category, 1 in the 200,000-500 category. Within rounding, categories I, J, K, and L sum to category H. "Transit commuters" does include rail which we exclude from these tallies.

[f] Inclusion of rail funds raises the amount for UAs over 1,000,000 to $2.37; the amount for UAs 200,000-500, to 2.28.

recipient's discretion in use of funds. At the low end of usage discretion, the ACIR lists project, formula-project, formula, and open-end reimbursement grants; in the middle are placed block grants; and at the high end is general revenue sharing. In actuality, the continuum is not as simple to operationalize as it might seem. First, the wide scope of categories legislated in transportation makes direct rankings difficult, although it is agreed that the preponderance of programs is categorical.[1] Second, it is the absolute amount of user leeway that provides flexibility; this latitude may be clouded by the context (or even semantics) of the program. For example, one could postulate a "strongly categorical program" (say, allocating funds on a strict formula basis for the purpose of advancing "only the maintenance aspect of surface-only transportation systems") which would allow for more flexibility than most any presently existing block grants. But regardless of how programs get classified or ranked, one must not overlook the sentiment among recipients that the easing of program restrictions is very desirable and will likely result in more effective overall usage of federal funds.

The strictly specified focus of a categorical program may well be necessary to achieve strictly specified goals. For example, a study performed by Charles River Associates concludes that bus purchases in 1974-1975 were approximately double what they would have been absent the federal

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[1] There are programs specifying that highways should be built, but some are for Interstates and others for ABCD. Some are for capital construction; others are for rehabilitation. One program is for a part of highways - bridges; 16 others (in effect in the 70's) are for safety. Some programs are for mass transit: UMTA Section 5 is for either capital construction or operating assistance, but at different matching ratios. And another program allows Interstate funds to be transferred to mass transit.

subsidy.[1] Sherman[2] and Rao (see Appendix C) have argued that the federal aid program for the Interstate system stimulated state expenditures. Park and Porter conclude that the five core ADHS states increased capital outlay, as a result of the ADHS program, relative to nine comparison states. Even bonded-indebtedness and gas tax rates were increased (see Figure 8 and Table 6 and Appendix D). But the question is, should buses double, should the ADHS program stimulate the region, and should UMTA stimulate capital investment in preference to maintenance, and rail in preference to bus? The implication is that, particularly with no agreed-on intermodal national transportation plan, strong categorical programs should be advanced with caution. Many transportation people (and we, too) agree with the conclusion of John Wells et al. that it is desirable to minimize the federal influences constraining local decision-makers in the absence of a clear-cut national objective.[3]

We add three further notes. First, a program of national interest may warrant a restricted user focus initially, but as the program matures and funding intent changes, user discretion should be increased. This appears to be happening, for example, with the provision of increased transfer percentages among ABCD programs. Second, we note the existence of "hybrids,"

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[1] Charles River Associates, Inc., Subsidies, Capital Formation and Technological Change: Mass Transit, prepared for Experimental Technology Incentives Program, National Bureau of Standards, Washington, D.C., November 1977, p. 177.

[2] L. Sherman, The Impacts of the Federal Aid Highway Program on State and Local Highway Expenditures, U.S. Department of Transportation, February 1975.

[3] John D. Wells et al., An Analysis of the Financial and Institutional Framework for Urban Transportation Planning and Investment, Institute for Defense Analysis, Arlington, VA; prepared for the Office of the Assistant Secretary for Policy, Plans, and International Affairs, U.S. Department of Transportation, June 1975 (PB-265-245).

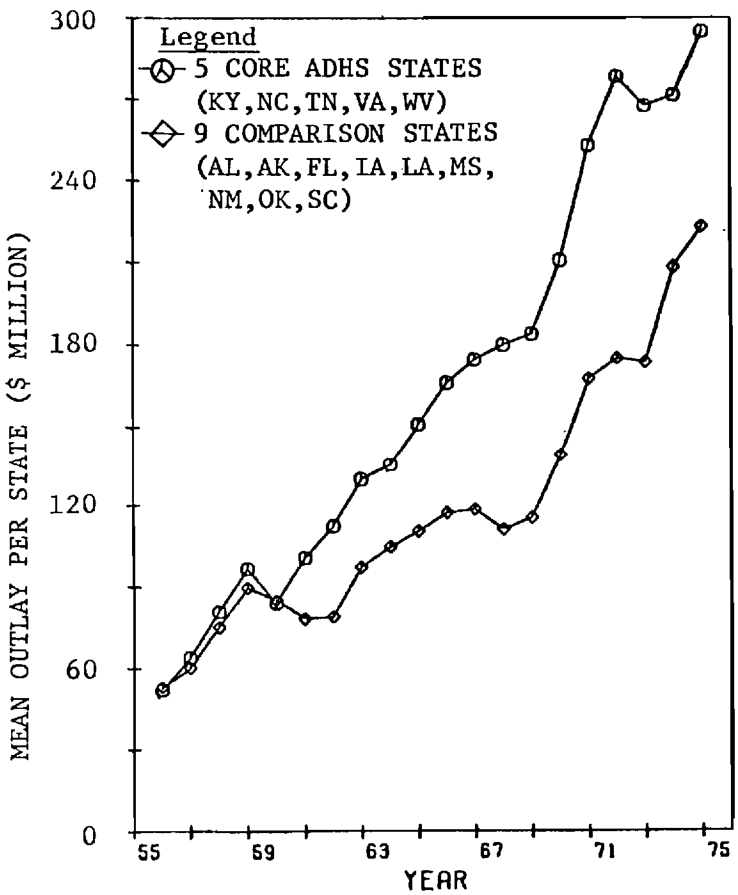

Figure 8. Total Capital Outlay for All Highways

Table 6. State Highway Bonds - Outstanding Debt at the End of Year ($ Million)

Mean \ Year	1961	1965	1969	1972
ADHS Core States	216.6	254.6	348.2	488.2
Comparison States	97.1	144.9	171.3	224.3
Difference	119.5	109.7	176.9	263.9

Source: U.S. DOT, Highway Statistics; Summary to 1975, Washington, D.C.

where a program is nominally categorical, but in reality acts somewhat like a block grant due to relaxed transfer provisions (again, the ABCD programs provide an example). The rationale for loosened categorical constraints appears to be mainly political - the nominal categoricality is useful for Congress to demonstrate to the constituents back home that they have been active in meeting a particular need. The loosening caters to the preferences of state and local transportation professionals for flexibility in allocating fiscal resources to areas of greatest perceived need. Third, the subject of red tape is often associated with discussions of user freedom. One interpretation of the upsurge in non-federal aid highway system activity in the 1970's is that states were taking that route as a recourse from federal red tape, e.g., environmental impact statement requirements. Regression analyses show a striking increase in administrative costs between 1957-1961, when $1.00 of federal highway aid was associated with $0.04 additional administrative expenses, and 1971-1975 when $1.00 corresponded to about $0.14 additional cost (Appendix C). (The increase in cost may be an acceptable price if it results in better planning or improvement in state highway construction design standards.)

In summary, we note that:

(1) Categorical grants should be specified with national orientation (intent 1).

(2) Block grants should be used when the intent is fiscal aid (intent 4).

(3) The reduction of red tape is obviously desirable.

As mentioned, the 1978 legislation includes changes along this dimension. Among these are the formation of a new categorical program with the separate appropriation for the Interstate 3-R program (maintenance); and an increase in the percentage transferable between A and B funds (from 40% to 50%) and between A and C programs (from 20% to 50%), thus making the ABC program act more like a block grant.

G. Open- Versus Closed-endedness

We only briefly touch on this dimension by noting that closed-endedness of a program, by which we mean limited, but specific, federal commitment to the program, can be a plus from the recipient's viewpoint. This helps the recipient planner in obtaining local funds (say from the state legislature), besides making long-range planning and administration easier. Such was the case in drumming up support for the early Interstate program and for the ADHS. However, closed-endedness is not without its "strings." As capital investment in the Interstate program is decreasing, states are finding tighter federally-imposed deadlines and obligation time limits that may cause problems in some cases.

A closely specified commitment for programs with nationally oriented intent (intent 1) or with a regional commitment (intent 2) seems logical, whereas such a commitment to intent 4 programs appears unnecessary, in general, to us. But this issue of open and closed funding commitments goes beyond just program planning and project administration. It also relates to funding sources, fund delivery mechanisms, fund allocation systems, and fund availability. These areas are left for future research, except to note that the time aspect can be quite important here. For example, the provision of contract authority, which enables recipients to obligate funds as soon as they are allocated, has given states a six-month head start in the highway program. And of considerable importance for airport allocations is that sufficient duration of availability of funds for obligation be allowed for accumulation for larger projects.

H. Further Issues: Fiscal Scarcity and Equity

Federal policy takes effect through the actions of state and local governments. Not surprisingly, their role can be highly influential in determining the effects of federal funding policies. This poses a difficulty for the analyst. On one hand, it is desirable to generalize on a national basis; on the other hand, one recognizes the idiosyncrasies of each state or locality. We suggest that the most suitable and most useful level of analysis is intermediate in nature. Focusing primarily on the states, we attempt to categorize their responses in a manner that will be helpful in understanding the effects of past policies and essential in formulating new ones. Toward this end we now focus on highways and then will turn back briefly to transit.

Discussions with state officials identified two items worthy of study. One was that a new era of fiscal scarcity arrived in 1973 (due to gasoline conservation following the oil embargo), replacing a prior extended time of abundance. The second was to distinguish among the states with respect to the extent to which they rely on federal highway aid. Together, these notions of distinctions over time (pre- and post-1973) and among states can help to explain the effects of federal aid policies.

The notion of a lasting period of fiscal constraint is of great concern in its implications for federal aid strategies. State officials suggested that this has led to a major change in their responsiveness to federal aid policies, particularly with ABCD programs. In previous years, federal aid was a useful contribution, but not a major force in determining the relative scale of construction activities. With fiscal constraints, however, states attempt to maximize their construction by taking full advantage of available federal funds and the most advantageous matching features. Since 1975, at least one state has stopped providing aid to local governments for highways other than to match federal aid; several have clear state policies to build only federal aid projects. Some states have even foregone allocated federal highway aid (an unheard-of happening in the past).

However, upon searching for statistical evidence to corroborate the specific instances of state fiscal scarcity generally and within the limited time frame for available data, we encountered a different picture. For instance:

1. The percentage of state capital outlay going to nonfederal aid roads was 13 percent in 1975, down only slightly from 14 percent in 1973, and up from the 6 to 8 percent level of the 1957-1969 period.

2. The ratio of capital outlay to total highway outlay was 52 percent in 1975, versus 51 percent in 1973, down only slightly from the peak Interstate years at 57 percent in 1965.

3. The rate of obligation of federal aid apportionments slipped somewhat in 1973 and 1974, but it had recovered for the Interstate system by 1975.[1]

4. States were able to respond to a massive release of impounded funds on a few months notice in 1975.

The picture is markedly unclear and deserving of further analysis.

One way to begin to clarify the recent financial picture is to classify states according to fiscal scarcity. As an illustration consider that in spring 1978, Illinois announced a three-fold increase in fiscal year 1979 highway expenditures, while at the same time Pennsylvania was completing an entire year without obligating any federal aid funds. There are any

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1. On average, states had fully obligated all their current year Interstate apportionments and were about 19% into their upcoming year ones by June 1975; whereas in June 1973, they had about 29% of that fiscal year's apportionment unobligated.

number of dimensions on which one could attempt to group the states to understand their patterns of response to federal aid programs. We have focused on two: reliance on the federal aid and extent of highway needs.

Table 7 illustrates the extremes of state dependence on federal funds. The highly dependent states tend to be the western, sparsely populated ones (nine of the 12 Public Land states are included in the 13 "dependers").[1]

As mentioned earlier, the measurement of transportation needs is difficult and controversial. We attempted a simple framework for understanding state response through the two dimensions of reliance on the federal government and extent of highway needs, looking at a number of need measures in the process (Appendix B). Additional work needs to be done here. This work may be informative, for instance in indicating which states may disregard federal aid unless the terms are highly attractive (e.g., low needs case, especially for highly self-reliant recipients), or which states may minimally match the available federal aid (e.g., highly dependent recipients, especially when their needs are low). Attempts to predict each state's performance after the '73 oil embargo based on such factors as "fiscal capability" and "need" have proved unsuccessful (Appendix B). Similar work by Miller[2] resulted in relatively little variance explained; perhaps Cooper's classification of states[3] will result in

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[1]In Rhode Island's case, a large share of the federal funds received in the past four years was for advanced construction of the Interstate System. These funds essentially reimburse Rhode Island for the federal share of Interstate projects which the state financed in the 1960's through special bond issues. See Cooper, op. cit., p. 37.

[2]E. Miller, "Effects of City Size and Population Density on Highway Usage and Needs," The American Journal of Economics and Sociology 37, No. 3, 1978, pp. 295-307.

[3]Cooper, op. cit., pp. 37-49.

Table 7. Fiscal Capability Measure 1: State Dependence on Federal Funds

State	Dependence (%)
"Dependers"	
Rhode Island	51.2
Montana	45.9
Utah	45.3
Nevada	44.1
Wyoming	38.5
New Mexico	37.0
North Dakota	35.5
Arizona	34.8
Oregon	32.5
Colorado	32.2
Idaho	32.1
West Virginia	31.2
Vermont	30.7
"Self-Reliers"	
Connecticut	13.8
New Jersey	15.9
Kentucky	16.2
Pennsylvania	16.4
Mississippi	16.4
New York	17.0
North Carolina	17.3
Delaware	17.5
Maryland	17.7
Oklahoma	18.3
Massachusetts	18.3
Florida	18.6
Indiana	19.1
Ohio	20.0
Wisconsin	20.3
Arkansas	20.7
Iowa	21.0
South Carolina	21.6
California	22.0
Illinois	22.1
Tennessee	22.3
Maine	22.3
Virginia	22.7
New Hampshire	23.1
Michigan	23.5
Louisiana	23.7

Note: % dependence is computed by dividing federal aid by total state highway expenditures on all roads, including construction and maintenance. Only relatively extreme states are listed and those states below dashed lines in each category should be considered "marginal."

Only 39 states are listed. The other states are between 25 and 30 percent dependence and hence are not placed in either fiscal capability category.

better predictors in this important matter.

For transit, the focus shifts to the local government level. As in the case of highways, transit needs are growing dramatically, especially for operating expenses. The federal role is becoming increasingly dominant, especially for capital improvements. There are deep concerns about the future ability of cities to support transit. Parallel issues thus arise in terms of formulating federal aid programs suitable to the abilities of the potential recipients at different points in time. In particular, we uncovered indications that large cities are more responsive to federal aid opportunities--in rapidity and extent of response (Appendix A). The states are increasingly participating in support of transit, adding another degree of complexity to the formulation of appropriate federal aid programs. One might categorize the states according to the level and type of state support provided in assessing the responsiveness to federal aid strategies.

To summarize, the characteristics of the recipients and the general economic situation of the time affect the response to federal funding programs. When resources are tightly constrained, a high matching ratio may be needed to allow participation, and the recipient contribution is unlikely to exceed the minimum matching requirement.

As a "footnote," we briefly consider equity. Equity is invariably an issue in the discussion of federal funding provisions; the major focus of concern lies in the redistribution of funds. Programs can be questioned as to the equitability of shared costs among users (e.g., cost allocation among highway or airport users contributing to the respective trust funds) or the propriety of support (e.g., general treasury support for a regional transportation program). Again, national interest can provide a good rationale for federal aid. In the absence of a strong national interest, one should consider whether federal funding involvement is desirable. It may be where non-federal units cannot generate sufficient resources, although revenue sharing may be a suitable response then in lieu of discrete federal aid programs. The option of no federal involvement, leaving funding to lower units of government often deserves consideration. Of course, in some cases, federal involvement to redistribute funds may be quite desirable. Then a suitable definition of equity must be agreed upon: should it be equal average (which is what we have used), or should it be equal absolute or equal marginal?

III. Perspectives: The 1978 Surface Transportation Act

A. Background

This section draws very heavily on comments received from some 21 parties-at-interest to the Surface Transportation Act and, more broadly, future transportation policy (see Acknowledgements). Our purpose here was to obtain a wide spectrum of views. Therefore, we do not claim that the opinions obtained are necessarily representative of the transportation mainstream or in agreement with ours. We try to present a consensus of opinion on particular issues whenever possible; in addition, specific points of view are noted. We then try to draw these perspectives together with the understanding of the implications of federal funding structures developed in Section II. Our hope is that this two-stage process will enable the interested reader to gain from the perspectives of those surveyed even if they disagree with our conclusions.

As discussed in Section I, we recognized the limited focus of our work. Our emphasis is on the structures used in federal aid transportation programs. As noted, during the course of our analysis we recognized that assessment of the funding structures could not take place without explicit consideration of the federal funding intents (Figure 1). As we now move to consider the 1978 Surface Transportation Act, we will retain the same perspective. That is, our primary focus is on the structural funding features of the Act and the intents to which they are directed. We should be very clear to indicate that the resultant analysis is by no means comprehensive; this is not an evaluation of the overall effectiveness of the Act in meeting transportation objectives (again, recall Figure 1).

Table 8 presents the major changes in funding provisions provided by the 1978 Act. These are the aspects to which we direct our attention.

Table 8. Major Changes in Funding Provisions of the Surface Transportation Act of 1978

	Provision	Change
1.	Transfers between Primary (A) and Secondary (B) Highway Systems	Ceiling up from 40% to 50%
2.	Transfers between Primary and Urban Systems	Ceiling up from 20% to 50%
3.	Federal matching share for funds transferred from Interstate to Highways	Increased from 70% to 85%
4.	Federal matching share for funds transferred from Interstate to Transit	Increased from 80% to 85%
5.	Federal matching share for Primary, Secondary and Urban (ABCD) Highways	Increased from 70% to 75%
6.	Federal matching share for Appalachian Development Highway System	Increased from 70% to 80%
7.	Interstate acceleration	Environmental Impact Statement and contract deadlines; no new designations; reduced time to obligate from 3.5 to 1.5 years; allow states to borrow (against future obligations) from obligational authority not used by other states; federal aid applicable to interest too.
8.	Bridge Replacement Program expansion	Greatly increased allocations; formula based (instead of discretionary) on needs survey; also $200 million discretionary fund; federal share increased from 75% to 80%; between 15% and 35% to be spent on non-federal-aid system bridges; functional as well as structural criteria approved.
9.	Transit Program changes	Routine capital investments, such as buses, moved to Section 5 (formula) from Section 3 (discretionary); subcategories defined in Section 5; apportionment formula changed; rural transit program (Section 18) set out.
10.	"3R" (resurfacing, restoring, and rehabilitating) Program changes	Interstate 3R as a separate authorization at 75% federal share on a separate formula basis; minimum of 20% of A, B funds to be used for 3R work.

Following the format of the questions posed to the transportation professionals, we consider in turn:

1. Easing of the provisions for transfer of funds among highway programs;
2. Increased federal matching share for funds transferred from the Interstate highway program;
3. Increased federal matching share for the Primary, Secondary, Urban Extensions, and Urban System (ABCD) highways, as well as for the Appalachian Development Highway System;
4. Provisions to accelerate completion of the Interstate system;
5. The greatly expanded bridge replacement program;
6. Changes in the transit program;
7. Changes in the 3R (resurfacing, restoring, and rehabilitating) programs.

B. Interview Results

1. Easing of Transfers Among Highway Programs

Most impressively, there were essentially no responses (from our 21 parties-at-interest) damning the move. The sentiment was that the changes in the '78 legislation should modestly increase the number of transfers (although a number saw essentially no change as likely), creating more rational highway systems. The increased flexibility in deciding where to allocate funds was likely to be helpful to many states and result in more effective overall usage of federal funds.

Two concerns were expressed, however. One respondent was uneasy about possible long-term transfer patterns distorting the overall federal aid systems, but did not see this as likely. One other was concerned about undue transfers away from urban needs, but did not really anticipate significant changes either.

Suggestions included the following. One party noted that reducing federal administrative drag over transfers might be more important than increasing the ceilings. Some would like to see changes go much further toward easing the transfer restrictions. Bruce Campbell of Fay, Spofford, and Thorndike, Inc., states

> The obvious federal philosophy behind the ABCD allocations is that 'the states would not be competent to allocate properly or might shortchange the rural or other roads, so we the Congress will have to do it for them.' This type of thinking should have died a long time ago. . . . Many thousands of dollars and man-days are wasted in each state to keep the books on federal funds. . . . Behind all this bookkeeping, the states have learned how to get around any federal limitations by allocating state funds as they wish. . . . In short, it is time for the Congress and FHWA to justify the need and reasons for allocations. It is very doubtful they can.

Broadening the critique to draw in issues about allocations between highways and transit, Gary Nelson of the Sierra Club adds:

> As I see it, the existing categorical restrictions are still very serious regarding transit vs. roads and construction vs. maintenance of both transit and roads. The (ABCD) modifications are just placebos really. Until a revenue-sharing approach is used, requiring only geographic and no programmatic restrictions, federal policy will continue to be an unwarranted distortion of local decision making.

2. Increase in Federal Matching Share for Funds Transferred from the Interstate Program

In general, our respondents foresaw relatively little effect from these changes (now an 85% match for funds transferred to either highways or mass transit). Only two respondents anticipated much increased transfer activity due to the increases in federal shares. There are some interesting speculations as to the net effect on the extent of transfers from highway to transit projects. Transfers to transit may be inhibited by uncertainty in general fund appropriations to cover them. On the other hand, energy shortages and gasoline price increases could encourage transfers to transit. Furthermore, the change in provisions could encourage political action to make cases for transfer transit projects.

The rationale for establishing these matching ratios is open to question. To quote Nelson:

> The resulting 85% match for non-Interstate programs appears to me to be a political compromise with no logical basis . . . the political factors behind the trade-in are relatively so great, either way, that the modest increase in the transit match will not be a big factor. I do have some concern for raising the alternative highway match to 85% up from the previous 70% however. This is obviously a relatively bigger incentive to build roads (i.e., with funds transferred from the Interstate program). . . . I feel that some remedial compensation is required so that the transit alternative has some edge on the road substitution. While this may seem to violate my dictum on trade-in equitability, the barrier to the transit trade-in is still operating expense and in this sense an equal road/transit trade-in is still a distortion in favor of the road.

3. Increase in Federal Share for ABCD and Appalachian Highways

The perceptions of our transportation professionals on this issue can be well accounted for if we consider both the direct and the indirect implications, both for fiscally prosperous and for fiscally strapped states. The dominant perception is that an increased federal share without commensurate increase in the level of federal funding implies a decreased "span" of federal programs. In other words, these changes are likely to result in a decreased level of programmatic effort. (We do note a minority view which suggests that an increased federal share will lead to an increased emphasis on the program involved, but we believe this is better explained in terms of interaction with the fiscal condition of the recipient.)

The majority of states are perceived to be fiscally prosperous today, although the future is perceived as fiscally hazardous. An increased federal aid share on a given program to these states will result in less pressure for the states to invest in that program. (Again, this assumes that any increase in federal aid level is insufficient to make up for the lost leverage due to the reduced local share.) This implies more flexibility with any state funds thereby made "excess" of matching requirements to spend where the state wishes. These freed-up state funds may be spent on the system in question, on another system, on maintenance, or so on. In general the prediction is that there will be a decrease in the level of construction on the program involved in most instances.

For fiscally strapped states (e.g., Pennsylvania in recent years), the results are almost the opposite. The increased federal share should increase pressure to invest in that program. The state (e.g., legislators) should be attracted by the high leverage on the state's own funds.

Some interesting indirect effects of the increase in matching share are worth considering. For one, pressure may arise for an increased level of federal funding on the program in question as prosperous states have "excess" funds without federal dollars available to match with their funds. Specific implications may be rather subtle. For instance, in Georgia, the increase in federal share for the ABCD system is not directly relevant to the state revenue allocation process. Georgia DOT presents the legislature with their indicated programmatic needs along with an indication of how much funding is available from the federal government in general, and, simply, how much they need in the way of state funds. On the other hand Georgia uses general funds (rather than motor fuel receipts) for work on the Appalachian Development Highway System. As a result of the increase in federal share for this system, Georgia DOT may have to "give back" funds to the state that are not required for matching purposes. This will result in no increase in programmatic effort on the Appalachian system in Georgia, although the increased federal share to 80% may help states like Pennsylvania. Or from another perspective, Appalachian highways do not compete with the

ABCD system in Georgia; therefore a differential in federal matching share is not particularly relevant.

4. Provisions to Accelerate Completion of the Interstate System

The combination of incentives, deadlines, and the prospect of active states gaining obligational authority at the expense of laggard states should serve to accelerate completion of the Interstate. However, effects are not likely to be uniform across the states and there are some troublesome quirks in the arrangement. States that have been lagging in their Interstate construction are likely to be stimulated to build or transfer funds (to other highway or transit projects) by the deadlines and the threat of the loss of obligational authority. Some active states will accelerate their Interstate construction as they push ahead to pick up the obligational authority from laggards. Other states already going as fast as practical will not significantly change their operations in response to the act. It is interesting that with one exception, the deadline for preparation of environmental impact statements was not seen as a serious barrier. This may be a perceived lack of credibility of the deadlines - people almost expect such deadlines to be extended as necessary. According to the AAA, "removal of budget constraints on obligations (up to the full capacity of the Trust Fund) would do more for accelerating completion than any other strategy."

Secondary effects of the Interstate acceleration are likely. In particular, as Interstate construction priority increases, the priority of other programs (e.g., ABCD, Appalachian Highways) will decrease given finite available resources. Gary Ceccucci of UMTA points out a possible untoward effect of the reallocation on a "first-come" basis of lapsed Interstate funds. This is apt to favor incompleted "rural" segments in fiscally conservative states, over "urban" projects.

The combination of accelerated Interstate work and the prohibition of defining new Interstate pieces to take the place of ones unlikely to be built and making transfers to other highway or transit projects more attractive should help wrap up the Interstate system. However, there is a certain nominal character to this "completion." As Pat Webster (National Transportation Policy Commission) sees it, we are simply "redefining it out of existence." The sense of this strategy is questioned by Bruce Campbell:

> On this latter point, I for one believe the congress is again mixed up on their priorities (as with ABCD allocations). The Interstate system is the backbone of our transportation system. It should be a dynamic system, with improvements, amendments, additions, changes, etc. as needed as time goes on. Yet, the Congress says it must be wrapped up immediately (in government, dates like 1983 and 1986 are tomorrow). Also, because of population growth, we can expect up to a 50 per cent increase in car registrations and vehicle miles traveled (VMT) by 1990. That's like locking the stable before the horses arrive. What's the rush? Why must the Interstate system planning and construction be rushed? Just so the Congress won't have to talk about it? What does the Congress, or anyone else for that matter, have in mind to absorb VMT increases or to adjust to new needs?

5. Changes in the Bridge Replacement Program

In general, transportation people perceive bridge needs as real and that this program will greatly increase work on bridges. The substantial scale of the new bridge program can provide a good fit for those states winding down their Interstate effort, but it may be tough for those with much Interstate work to go as well. The availability of professionals needed to conduct the needs inventory and to prepare projects may be a bind for some states. Hence, there may have been some advantages in a more gradual buildup of this program.

In general people approve of the priority needs basis for bridge program allocations, even though the inventory procedure will be difficult for some states (not so for others). The flexibility to replace or upgrade, for structural or functional reasons, is generally perceived as good. This program is seen as likely to remedy previous distortions due to categorical restrictions. For example, in some cases roads were widened, but bridges were not; in some cases bridge work not affiliated with an ABCD road project was simply not done.

The small matching differential (80% for bridges vs. 75% for ABCD) is not perceived as very important. It may help some poor localities and states to participate in the program. Furthermore, some states will help with the local match (i.e., on non-federal aid roads).

The provision of funds through a large formula allocation program with an additional discretionary allocation is perceived as quite appropriate. In general, highway people prefer the predictability and incorruptibility of formula programs. Yet no one seems to doubt the availability of suitable projects for this partially discretionary program.

Several see great needs off the federal aid system and like the flexibility provided by funding for off-system bridges. Several others seriously question the logic of federal aid here in the absence of a significant national interest in such bridges. As the AAA puts it:

> Extension of federal aid to off-system bridges, however, can seriously reduce the financial capability to upgrade and preserve the most important (from a federal interest viewpoint) road network. Roads and bridges which are not on federal-aid systems should be funded with state and local funds and not with federal aid.

We note that the inclusion of off-system bridges is attributed to a political decision, resulting, in part, from a major push by the national association of counties for such aid.

A further voice of dissent should also be noted, "As usual, Congress has tried to solve the problem in the way that the problem was originally created: by throwing a pot of categorical money at it. I disagree entirely with the concept of the program." Indeed, this new categorical program will also force state and local priority allocation decisions between this and other aid programs. Campbell notes, "Of course, the 'between 15% and 35%' set up three new funding categories to be tracked by states, bringing categories to above 70 in number."

6. Transit Program Changes

Changed provisions will allow an easier flow of federal funds for routine capital needs (buses). Shifting such capital improvements to the formula program is generally perceived as good, although some funds may go unused because local authorities lack funds for their matching share. Furthermore, reductions in the scale of the discretionary section 3 program will make it more difficult to start new programs.

Professor George Smerk of Indiana University points out that the provision of section 18 aid to help small cities with transit is an important change.[1] This may give a real boost to such efforts, or it may just substitute for state aid. Allen notes that as programs rely more heavily upon formula allocations, the precise composition of that formula can become very important.[2]

The increased number of subcategories results in dividing a given pot of money more finely. This may cause problems in matching the dollars to actual needs. Gary Ceccucci points out:

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[1]G. M. Smerk, "Federal Mass Transportation Policy: The Surface Transportation Act of 1978," Transportation Journal, Spring 1979.

[2]G. R. Allen, "An Analysis of Subsidy Issues in Public Transportation," Traffic Quarterly, October 1976, pp. 595-614.

> It is ironic that the STA Act has made the highway assistance program more flexible and discretionary, while increasing the number of categorical, formula-based transit programs.

In addition some people look harshly upon the continued distinction between capital and operating expenditures, considering this to be a distortion of local transportation priorities.

7. The 3R Programs and the Issue of Federal Support for Maintenance

The 3R efforts are generally seen as highly useful. As the American Trucking Association puts it,

> In many cases, the broadened 'construction' definition will permit '3R' work that was formerly called maintenance to be classified as capital improvement, and thus eligible for federal aid. This is a positive step. . . .

States approve the 3R program, but don't welcome federal aid on "straight" maintenance because of anticipated red tape problems and patronage jobs.

Several respondents noted that they approved separate status for the Interstate 3R program, but strongly disapproved the decreased federal share at 75%. In tune with the general objection of undue federal interference in local allocation decisions, there was some resentment at the 20% requirement for ABCD 3R work. This was perceived as "unnecessary, undesirable, and too restrictive." Yet most respondents feel that they will do more than the 20% level anyway.

An intriguing observation was that an increased level of support for the railroads could prove an effective way to reduce Interstate 3R costs.

C. Synthesis

We now synthesize the funding parameter aspects of the 1978 STA with our results from section II. This synthesis will be organized by funding-package dimensions rather than by features of the act.

1. Level and Matching Ratio

Our respondents believe that the ABCD and ADHS increases in matching ratio will decrease overall program sizes. In particular, they feel that fiscally-strapped states will increase program size, while more prosperous states will decrease their sizes. (As the perception is that there are more prosperous states than fiscally-strapped, the national effect will be toward decreased program effort.) One interesting indirect effect is that states might request increased federal spending to pick up the resulting slack in program size. Another indirect effect is related by Gary Nelson and reflects concern for the impact of increased federal involvement on localities:

> An analysis of mine for NY in 1976 showed that the localities were spending $1 billion of their own local revenue bases for highways whereas the State was passing back only about 16¢ on the dollar of highway user revenues raised from localities. My contention is that making transport more of a state-federal game by increasing overall federal amounts will just encourage the States to keep more revenues in their coffers for State programs and continue to short-change localities. The fiscally tight localities will, of course, dominate over a continually deteriorating local system.

Regarding the absolute level desired for federal matching shares, our respondents did not present a uniform stance. There was some sentiment for uniformity, but they felt it was not a simple matter to determine an even-handed balance between capital and operating assistance support levels, or between highway and transit programs, because of differences in the apparent relative cost of operations, for example. (One thoughtful suggestion to better take this into account is the notion of providing funding on the basis of life cycle costing, to not unduly encourage capital investment.[1]

[1] M. Wachs, and J. Ortner, "Capital Grants and Recurrent Subsidies: A Dilemma in American Transportation Policy," Transportation, Vol. 8, 1979, p. 17.

Somewhat along these lines, there was considerable sentiment to provide Interstate "3R" aid at the same 90% rate as the Interstate construction.) Some of our respondents suggested a smaller federal share in programs that did not reflect compelling national interest. In our earlier draft report (July 1978) we made a suggestion to that effect as well. Now we disagree. Given that the intent of a funding program is not primarily to stimulate recipient investment (intent 3, Table 1), a smaller federal share is generally not going to be appropriate. If the aim is to provide fiscal relief to the recipient, the lower federal share may exclude participation by some potential recipients. Most importantly, the smaller federal share will leverage additional state and local investment in the program in question. This is not appropriate since we began by asserting that the program was not of compelling national interest; hence there is no rationale for inducing recipients to invest more than they otherwise would choose to do.

On the other hand, there are pitfalls in high federal matching shares as well. While these may indeed broaden program participation, they are likely to induce pressure for an increased federal funding level to maintain programmatic effort. Most seriously, high federal matching shares induce uneconomic, low benefit/cost ratio projects. Simply put, at 5¢ or 10¢ on the dollar, almost any project can be attractive to local decision makers.

Any future study of matching shares ought to consider the role of the states as well. Some states provide support to their local communities in meeting matching share requirements, on certain sorts of projects. For instance, a 1976 survey by the American Association of State Highway and Transportation officials found that 24 of 47 states reporting contributed to transit capital matching requirements. This could be a major influence on the course of federal aid investments. It would be quite interesting to compare the investment profiles across different federal aid programs according to the matching support provided by the respective states.

From our perspective, analysis of the ABCD and ADHS matching ratio increases in the 1978 act again rests heavily upon the perceived funding intent. As we perceive the intent for the ABCD system to be chiefly financial relief for the states, decreased leverage and associated increased state flexibility in allocating state funds is a good step. The Appalachian Development Highway System, on the other hand, is seen by us as reflecting regional development intent. We thus support a categorical program in this instance, with a matching ratio to be carefully balanced according to recipient ability to lead to the largest sensible programmatic effort.

We suggest that it would be valuable to monitor the actual ABCD program levels to see how these change from before the passage of the 1978 Act. It would be particularly interesting to track the patterns of federal and state investment in these programs as a function of state financial condition[1] to see if our assessment is correct.

2. Formula Versus Discretionary Grants

Concerning formula vs. discretionary allocations, most professionals lean toward the formula based on continuity to enhance planning possibilities and the absence of possibilities for corruption of the allocation process. However, it is noted that formulas cannot perfectly match all needs, thus contributing to under- and over-building at the same time. In some cases formula grants may spread the resources so thin that many recipients

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[1] T. W. Cooper, The State Highway Finance Outlook, U.S. Department of Transportation, Federal Highway Administration, Office of Program and Policy Planning, December 1978.

don't get enough to make useful investments. Discretionary grants are able to handle projects large in scale relative to a recipient's program budget. A disadvantage of discretionary allocations is that they tend to encourage ad hoc projects. These in turn are more liable to cost overruns since there may be less incentive for the recipient to learn or to establish credibility with the sponsor for future projects.[1]

With respect to the 1978 changes specifically, we view the bridge move to some discretionary funding as good because of the existence of large "R" projects in this domain (see Section IIE). Correspondingly, we see the shift of routine transit capital needs (buses) to a formula program as wise.

3. Categorical Versus Block Grants

In the categorical/block grant dimension, the 1978 STA eased transfers among highway programs (as well as transfers from interstate projects to highways or mass transit), formed a new categorical program for bridges (including aid for non-federal bridges), and increased the number of subcategories in a transit program. The sentiment among transportation professionals weighs heavily for fewer categorical restrictions. Bruce Campbell states:

> As for the Act, reduction in categories (as mentioned before), and red tape doesn't seem to happen, despite claims they will be reduced. Three categories of highways (Interstate, Safety, Other) would be very adequate. Fewer categories would help the states juggle Federal and State funds for projects.

Some would like the easing of intermodal restrictions; others would like to remove the distinctions among construction, maintenance, and operations. "Faddishness" is a side point of greater concern with respect to categorical

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[1] M. Wachs, and J. Ortner, "Capital Grants and Recurrent Subsidies: A Dilemma in American Transportation Policy," Transportation, Vol. 8, 1979, pp. 3-19.

emphases (e.g., federal pressure toward heavy rail transit systems, followed by federal opposition a few years later).

In general, we feel that if a program is in the national interest in terms of funding intent, then it should be safeguarded by categorical restrictions that insure that national priorities are followed. If this is not the case - in particular, if the funding intent is primarily fiscal relief on programs of recipient interest - block grants are in order. Alternatively, one might shift the revenue generating burden to the state and local entities in such cases. If neither of these options is politically feasible, then increased transferability among associated categorical programs makes sense (e.g., as has been done for the ABCD program).

With respect to bridges, we believe funding intent is again the critical issue. There seems to be a bit of a paradox in this situation where aid is specified for off-system bridges in the guise of another categorical aid program. Why should the federal government be specifying what percentage should be spent on these bridges of little or no national consequence, and why should a different matching share be provided than for the basic ABCD program? As we see the justifying funding intent for this program, it must be predominantly fiscal relief for projects of state and local interest. In that case, funds should be provided with the minimal strings attached - the revenue-sharing model would appear quite appropriate. With respect to the additional categorization of transit programs, we are disappointed in the recent legislation as we see transit aid as intent 4.

4. Open- Versus Closed-Endedness

The winding down of the Interstate program through its accelerated completion is the key feature of the legislation in this dimension. Our respondents postulated that both laggard states as well as active states will build rigorously; those states more in the middle will not be affected. Secondary effects include decreasing the priority of other transportation programs where Interstate efforts are increased.

From our perspective, we believe that the federal commitment to complete the Interstate system from its inception was critical in establishing this categorical program as a national priority. On the other hand, it seems time to reconsider the national interest in the Interstate system and in its quick "completion." For instance, transfers are, by definition, of "nonessential Interstate segments." If this is the case, questions could indeed be raised about the necessity for rushing completion. Likewise, the prohibition of redesignating new Interstate segments will certainly encourage completion of the "system." However, in practical terms, what is the difference between completion of a system without such new segments and delay occasioned by work on such new segments? (In actuality, the combination of the prohibition with the possibility of other states picking up unused obligational authority should foster completion of the given system.) It would seem that any restructuring of the incentives for Interstate acceleration should be based on careful consideration of the national interests involved.

Analysis of the "before" and "after" Interstate program effort attendant to the 1978 legislation would be useful in formulating future policy changes. Changes in obligation rates according to whether a state were previously active or lagging in its Interstate program, actual lapsing of Interstate obligational authority then picked up by other states, and transfers out of the Interstate system to highways and to transit would all be extremely interesting. In addition while changes in programmatic activity levels on other systems are determined by many factors, it would be interesting to see if there are any apparent relationships to the enhanced Interstate priority occasioned by the Act. For instance, one might determine whether there is correlation between increased Interstate activity and decreased Primary, Secondary, or Urban system activity.

IV. Conclusions and Critical Issues

The reduction of federal distortions that promote uneconomic investments for no clear national purpose, as called for by an overwhelming majority of our respondents, must begin with some clarity about those purposes. As Professor Smerk states, the Surface Transportation Act of 1978 reflects compromise,[1] not a plan of action to meet long-term goals:[2]

> The key reason for federal funding of anything is that somebody did a good lobbying job and a compromise was reached. Without the proper framework of goals, objectives, and action plans, none of the funding of any of the programs makes sense. As it is, we are primarily throwing money at particular programs and hoping that something good will come of it without ever really knowing what that 'good' is.

In particular, the setting of funding levels, matching ratios, and categorical/block provisions cannot be ascertained without a clearly-defined national, intermodal policy. One step towards a basis for establishing funding structures is a prioritization of transportation programs.[3] As an input to this type of ranking, we have taken our respondents' comments and (roughly) formed a composite ordering from greatest national interest to least, as follows:

- Interstate
- Interstate 3R
- Railroads
- Airport Development Aid Program

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[1] U.S. House of Representatives, 95th Congress, Second Session, Surface Transportation Assistance Act of 1978, Conference Report, No. 95-1797.

[2] G. M. Smerk, "Federal Mass Transportation Policy: The Surface Transportation Act of 1978," Transportation Journal, Spring 1979, p. 33.

[3] Eno Foundation Board of Directors and Board of Consultants, Report on Joint Conference, Traffic Quarterly, April 1978, pp. 173-262.

- Bridge Replacement Program
- ABCD Program (with Primary at higher priority than Urban, at higher priority than Secondary)
- Regional development programs such as the Appalachian Development Highway System
- Transit aid.

Some specific comments add flavor to the ordering. Railroads are noted as inherently interstate and of real national interest (again it is notable that we did not inquire about them). Some doubt the national interest in the airport program - finding the argument for it interesting but not compelling, in that sizeable airports could support themselves. The bridge program's priority is elevated by the perceived need being greater than state and local ability to pay. Regional development, and also in at least one respondent's view, transit, reflect national interests to develop our human and natural resources, more than transportation interests per se. Some would like to see an urban transportation system (highways and transit) supported by a formula block grant program which allows maximum local discretion.[1] From our perspective, categorization efforts such as these are difficult, but vital. Funding and funding structures should be chosen on the basis of what the national interest is.[2] Gary Nelson suggests that

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[1] A. E. Bauer, "Solving Transportation Problems in the Federal System: Is There a Role for State and Local Governments?," Publius, The Journal of Federalism, Vol. 8, Spring 1978, pp. 59-76.

[2] Our analysis has not focussed on the sources of funds. However, it should certainly be noted that the rationale for federal funding efforts depends on the sources. Namely, the trust funds established for highway and airport users to contribute to the development of their respective systems contrast with programs supported by the general funds. Of course, this is no simple distinction - some feel that such modal trust funds distort intermodal priorities with serious ramifications.

the prioritization process must be clarified by discerning two possible, national goals:

> One dimension is the priority with respect to national efficiency contributions that are uniquely achievable by federal action. The other is the federal interest in distributional ends. Let me only suggest that rail would head the former list and transit aid would be very high on the latter list. You see, the rationale for federal aid to transit is that it redresses the past federal transfers out of cities and away from transit. It is a distributionist function that is in fact the result of inefficient federal policy.

Regardless, however, of how these lists are generated, we emphasize with Smerk that national goals and objectives must be integrated with economic policy, environmental policy, energy policy, and urban policy. This is an extremely difficult exercise but one that would be most worthwhile in terms of the long run benefits to the nation and to the transportation system.

Beyond the issue raised above regarding national objectives, clarification is needed of intergovernmental funding roles. In addressing this controversial question, it is important to note changing circumstances. For one, as Mills notes[1], if indeed there is a declining national interest in building transportation's infrastructure, decentralization of decision making is a natural consequence. On the other hand, while some question the wisdom of increasing reliance on federal aid[2], many feel the need for continued federal aid. The relative roles of the federal and state governments involve judgments as to which is able to make more effective allocations and equitable assessments. Do the states still need a strong federal hand to build facilities of proper quality, properly cognizant of related interests (e.g., environmental protection)? Should the federal government

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[1] W. R. Mills, "Fiscal Issues in National Transportation Policy," Traffic Quarterly, Vol. 33, April 1979, p. 317.

[2] J. L. Weller, "A Perspective of Transport Finance in the United States," Traffic Quarterly, October 1975, pp. 481-498.

be involved in the redistribution of revenues in support of transportation - among states, between urban and rural areas, or between modes? Cooper's analysis[1] finds wide state-to-state variations in federal aid, bonding, and tax effort suggesting that some states may be overcapitalized and/or some undercapitalized. For instance, Indiana and Delaware both derive about 48% of their support from federal aid, but Delaware is heavily bonded (44% of its revenue vs. 0% for Indiana), and exerts a considerably greater tax effort (1.59 on a constructed scale vs. 0.93).

Similarly, state and local roles can be called into question. For one, the relative voice of smaller urbanized areas in programming of urban system and transit funds is a point of contention. As one respondent put it (and we concur):

> By and large, my personal prejudice would be to finance transportation on the smallest geographic basis that is reasonable. I think this promotes a more cautious and efficient development of facilities.

These are critical questions raised about the appropriate federal role (no less that of the state and local governments as well). Future policy-making should not ignore these questions concerning the appropriate extent of federal aid and of federal constraints upon transportation decisions.

The clarification, both of national objectives and of funding roles, will become more important as the present transportation situation is exacerbated by future developments. The development most mentioned by our respondents and others[2] is that of adjusting revenues to provide sufficient

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[1] T. W. Cooper, The State Highway Finance Outlook, U.S. Department of Transportation, Federal Highway Administration, Office of Program and Policy Planning, December 1978, pp. 38-39.

[2] E.g., A. E. Bauer, "Solving Transportation Problems in the Federal System: Is There a Role for State and Local Governments?," Publius, The Journal of Federalism, Vol. 8, Spring 1978, pp. 59-76.

funds despite inflation. This is a problem for all levels of government. Pressures exist on the federal highway trust fund, on federal general funds, on state revenues generated from motor fuel taxes, and so on. According to a 1977 survey, most of the states are not generally too bad off right now but see their future as questionable.[1] States have difficulty in increasing highway funding - 33 of 41 states considering such an increase in 1977 were turned down.[2]

The shift from construction toward maintenance, rehabilitation, and operations is a significant feature for both highways and transit. In particular it requires redefinitions of the federal funding role and careful determinations of equitable funding strategies. The bulk of the federal aid programs are devoted to capital improvements. However, as transportation moves toward an emphasis on maintenance and operations, these programs may exert an undue distortion in favor of continued construction activities. In many cases the additional capital improvements may incur even greater operational costs in the future. Furthermore, the notion of increasing capital plant may run counter to other national objectives, such as energy and materials conservation, and the provision of increased employment opportunities (operations-intensive efforts may be more labor-intensive than capital investments, e.g., bus vs. rail transit).

Bruce McDowell (Advisory Commission on Intergovernmental Relations) summarizes the three most-cited critical areas:

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[1] T. W. Cooper, The State Highway Finance Outlook, U.S. Department of Transportation, Federal Highway Administration, Office of Program and Policy Planning, December 1978.

[2] W. R. Mills, "Fiscal Issues in National Transportation Policy," Traffic Quarterly, Vol. 33, April 1979, p. 314.

The most critical problems for transportation which I foresee over the next few years are (1) shifting programs from an emphasis on construction to an emphasis on maintenance, rehabilitation, and operation of transportation systems, (2) adjusting revenue sources to a basis which keeps up with inflation despite energy conservation efforts (perhaps a sales tax based on price rather than number of gallons of gasoline), and (3) moving away from narrow categorical grants toward integrated intermodal transportation grants with fewer restrictions on the use of funds among not only the modes but also the categories of construction, maintenance, rehabilitation, and operations.

Three other problems are also very notable: energy saving, rail revival, and enhancement of mobility. Clear energy policy with respect to transportation development is needed. More efficient and more effective use of private vehicles is likely to be important. Increased transit demand and increased emphasis on transit for the purpose of energy conservation are possibilities that could significantly alter federal priorities. Despite the fact that our questions posed to the transportation professionals focussed on the Surface Transportation Act, several mentioned revival of the rail system as a critical problem. (A related critical problem is that of user-charge financing.[1]) This has seemed to have important multimodal implications in terms of rationalizing the overall transportation system. Mobility is seen as being hampered by localized congestion and transit inadequacy.

Strategies to deal with these problems must, above all, respect the interactions among them. For instance, tolls may serve to reduce congestion and provide revenues. (However, tolls may be viewed as piracy if they are used, as in the case of the New Jersey Turnpike, to promote educational systems!) Likewise, increased fuel taxes can provide revenues

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[1] Fred Lee Smith, Jr., "An Efficiency Assessment of the Highway User Charge System." (Internal memorandum, Association of American Railroads, Washington, D.C.)

and encourage energy savings. Gasoline conservation measures may reduce vehicle miles of travel, thereby enhancing mobility, but also squeezing state and federal revenues. Demands for energy will also have direct effects on transportation systems (e.g., coal-haul roads for out-of-state uses). Funding in such cases may be federal, or, as Kentucky is doing, state bonds amortized by a severance tax on the coal.

The reality of these critical issues, in the light of our conclusions above, leads us to the recommendations offered (see Summary and Recommendations section).

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX A

MASS TRANSIT

by

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15. Supplementary Notes

16. Abstract This analysis concerns the manner in which Federal funding structures affect mass transit. It focuses on the implications of categorical versus block grants, different required local matching shares, and formula versus discretionary aid programs. This work is part of a broader study that addresses the effects of funding structures across the highway, airport, and transit modes.

The report is structured with each of the discrete analyses available separately as follows:

Appendix A, Mass Transit
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

	page
Summary	iii
I. Introduction	1
II. Patterns of Response	3
A. Rail System Funds	5
B. Distribution Among Urbanized Areas	6
C. State Influences	12
D. Time Patterns of Response to Federal Initiatives	14
III. A Choice of Four	20
A. Use of Urban System Funds for Transit	22
B. Interstate System Transfers to Transit	25
C. Section 5 Funds: For Capital or Operating Expenses?	25
IV. Implications of Federal Transit Funding Structures	26
A. Overarching Factors	26
B. Categorical vs. Block Grants	28
C. Matching Requirements	30
D. Discretionary vs. Formula Grants	31
E. Long Term Surety	32
F. Hybrids	32
G. Funding Structures vis-à-vis Public Transportation Objectives	33
H. Indirect Effects of Transit Funding Structures	35
V. Some Observations on Current Proposals	36

Summary

This analysis concerns the manner in which Federal funding structures affect mass transit. It focuses on the implications of categorical versus block grants, different required local matching shares, and formula versus discretionary aid programs. This work is part of a broader study for the Office of the Secretary, U.S. Department of Transportation (P. J. Barbato, monitor) that addresses the effects of funding structures across the highway, airport, and transit modes.

The findings presented here reflect a synthesis of statistical analysis, interview, and literature review. The statistical base is the record of Urban Mass Transportation Administration (UMTA) financial assistance projects from 1965-1977, buttressed by socio-economic information on the urbanized areas and the states. Interviews with a variety of transportation professionals at the Federal, state, and local levels augment the factual data.[1] A number of recent analyses focused on different aspects of public transportation funding contribute to the present conclusions.

Federal involvement in public transportation funding is significantly colored by three features:

- transit needs are growing dramatically, especially for operating expenses;
- the Federal role is becoming increasingly dominant, especially for capital improvements;
- a key differentiation can be made between rail and bus activities; rail aid is concentrated in some seven cities but it represents about 70% of current capital obligations.

The distribution of UMTA funds per transit commuter for the capital assistance (Section 3), planning (Section 9), and formula grant (Section 5) programs has been remarkably uniform across different sizes of cities. Not surprisingly, on a total funds or per capita basis, UMTA aid has favored the large cities with well-established transit operations. In contrast, the Section 5 grants have been proportionately more of a factor for small cities; and they have been more inclined to use these funds for capital improvements.

Large cities tend to be more responsive to Federal aid opportunities in the transit realm. The increase in Federal share from 66 2/3% to 80% in fiscal 1974 did appear to stimulate participation by the smaller urbanized areas, especially those who had not previously participated.

The states are providing more and more transit assistance to localities. However, this analysis could not statistically document state influence on the distribution of Federal transit funds.

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[1] We deeply appreciate the insights offered on current and future policy issues by the many knowledgeable transportation officials acknowledged in our overview report.

I. Introduction

The provision of urban public transportation services is a matter of deep current concern. This concern has evidenced itself in a variety of policy issues at the Federal level, but the key element is that of funding. At the heart of the urban transportation dilemma is mass transit. This paper attempts to assess the implications of recent Federal funding policies upon transit.

Transit funding is an issue of substantial magnitude, and it is growing. The 1974 National Transportation Study projected a "need" for $58.2 billion in capital investment for transit to the year 1990.[1] This works out to some $3 billion per year (a figure probably on the high side, given the process of need estimation). The report projects annual operating costs at $7.2 billion by 1990. Furthermore, it projects that farebox revenues, which covered 85% of operating expenses in 1972, would only cover 65% by 1990. However, this projection appears too optimistic - revenues covered only about 50% of the $4 billion operating costs in 1976.[2] The pattern that emerges is thus rather threatening. Capital and operating needs are increasing rapidly:[3]

1970: capital outlays = $0.4 billion; operating deficits = $0.3 billion

1976: capital outlays = $1.3 billion; operating deficits = $1.9 billion

The Federal government plays a major role in this financial picture.

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[1] U.S. Department of Transportation, <u>A Study of the Urban Mass Transportation Needs and Financing</u>, Washington, D.C., July, 1974.

[2] American Public Transit Association, <u>'76-'77 Transit Fact Book</u>, Washington, D.C., 1977.

[3] Capital outlays for fiscal years are taken from U.S. Bureau of the Census, <u>Census of Governments</u>, 1969-70 and 1975-76, Washington, D.C. Operating deficits are from the <u>'76-'77 Transit Fact Book</u>.

For fiscal year (FY) 1976, the Urban Mass Transportation Administration (UMTA) provided some $1.4 billion in capital assistance and $0.4 billion in operating aid. This Federal aid is provided to local transit authorities to further national urban transportation objectives (see Section IV G).

Various Federal funding structures are used in this context. The UMTA aid program derives principally from the Urban Mass Transportation Act of 1964 and its extensions, although the 1973 Federal Aid Highway Act has had substantial implications too. These Federal provisions affect a diverse clientele, ranging from the largest urbanized areas (UAs) with huge fixed rail systems to transit authorities operating small bus fleets.

Transit is most heavily concentrated in the largest UAs. UAs over 2,000,000 (1970 Census) are anticipated to account for 76% of the 1972-80 public transit expenditures (and only 31% of the highway expenditure) for 45% of the urbanized area population.[1] In terms of passengers, transit service is primarily provided by public systems (91% of the revenue passengers in 1976). The 375 public systems represent 39% of the industry total number in 1976, versus only 7% in 1964.[2] The diversity of local legal constraints, type and extent of fiscal resources, and political situations significantly interact with the Federal aid programs.

The purpose of this analysis is to elucidate the effects of different Federal funding strategies. Toward this end, local investment patterns in response to Federal funding structures are the primary focal point. The analysis is presented in two sections. First, the patterns of local response to Federal transit funding initiatives are described. Second, local

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[1] U.S. Department of Transportation, The 1974 National Transportation Report, Washington, D.C., July, 1975.

[2] The 1976 data are from the '76-'77 Transit Fact Book, op. cit.; the 1964 data are from the 1974 National Transportation Report, op. cit.

preferences among four alternative sources of Federal aid are compared. These serve to provide useful insights as to what aspects of Federal funding policies make a difference, with consequent implications for future policies.

The present intent is to throw light upon the pro's and con's of various funding strategies. For instance:

- What happens to total effort when Federal matching share is increased?
- What are the programmatic implications of tight categorical restrictions placed upon the recipient of Federal funds?
- What differences arise from use of an apportionment formula rather than the making of discretionary grants?

In light of this interest, a limited set of instances are examined to provide the most useful evidence on the implications of these funding parameters. In particular, the changes resulting from the 1973 Federal Aid Highway Act and the 1974 National Mass Transportation Act are of concern. The intent is neither to evaluate these acts, per se, nor to assess the overall UMTA program. Rather, it is to clarify what effects are attributable to changes in the Federal funding structures. This aims to provide useful information as policy-makers ponder further alterations in Federal transportation funding strategies.

II. Patterns of Response

There are a number of essential dimensions to a discussion of the response to Federal transit aid opportunities. First, of course, are the UMTA aid categories, of which this analysis addresses:

- Section 3 - discretionary capital assistance grants

- Section 5 - formula grants, some used for capital improvements and some to defray operating expenses
- Section 9 - grants for technical studies[1]

Funds provided through any of these Sections may be devoted to fixed-rail or other transit endeavors. Most of these analyses separate out the rail grants because of their special character - large dollar amounts in few projects to very few cities.

A major concern is the distribution of funds by type of urbanized area. This analysis relies heavily on the UA categorization used by UMTA in its report on "Transit Operating Performance and the Impact of the Section 5 Program" (November, 1976):[2]

1) urbanized area population over 1,000,000 (25 UAs)
2) " " " 500,000-1,000,000 (21 UAs)
3) " " " 200,000-500,000 (58 UAs)
4) " " " 50,000-200,000 (163 UAs)

The characteristics of the states are investigated to see to what extent they affect localities' responses. Geographical distribution of UMTA funds is of some interest. In addition, description of the timing of grants is helpful in exploring the responsiveness of localities to Federal initiatives. Particular note is taken of the timing of grant requests of the smaller UAs.

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[1] See Footnote a to Table 1 for an accounting of the data base.

[2] There are presently 278 urbanized areas. We have consolidated six of these that are paired in the same SMSA (Tampa, Winston-Salem, Beaumont, Salinas, Galveston, and Oshkosh) because we have obtained some data on an SMSA basis. In these cases we have used urbanized area statistical data for the larger of the two involved. We have not included four urbanized areas in Puerto Rico, nor one in Alaska (except for special tabulations). Thus, the net talley is 267 UAs.

A. Rail System Funds

Rail system assistance from UMTA has been heavily concentrated in a few large, Northern cities. By our classification, all but $4.6 million out of $1.35 billion attributable to specific cities went to UAs over 1,000,000 population.[1] The 140 rail projects included 100 Section 3 capital improvements, 3 Section 23 highway transfers, 12 Section 5 formula grants, and 25 technical studies. Fifteen were not attributable to a specific UA; 101 of the remaining 125 went to Boston, Chicago, New York, Philadelphia, and San Francisco. The remaining 24 projects attributable to other UAs accounted for only $188 million (of which Atlanta received $73 million and Washington, D.C., $66 million).

The Congressional Budget Office ("Urban Mass Transportation Options for Federal Assistance," February, 1977) summarized the current allocation of capital funds as going about 30% for buses, 35% for completely new rail systems (i.e., Atlanta, Baltimore, Buffalo, and Miami), and 35% for rail improvements and extensions in cities that already have rail networks (i.e., Boston, Chicago, New York, Philadelphia, San Francisco, Cleveland, Pittsburgh, and Washington, D.C.).[2] In sum, rail capital aid dominates bus capital aid, and it is highly concentrated in a few cities - but those are the cities with the largest numbers of transit users.

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[1] We classified projects as rail when the project description clearly indicated involvement of rail components.

[2] Classification is ambiguous. Washington's system is new, but operating. Some systems are heavy rail; some are light rail. Trolley coaches are in use in five cities; cable cars in one. The commuter railroads not only serve UAs such as New York and Chicago, but also connecting ones such as Hartford. There are some eleven cities currently approved for downtown people-movers.

B. Distribution Among Urbanized Areas

The basic statistics comparing the distribution of Federal transit funds by size of city are presented in Table 1. Some of the highlights are:

- large cities obtain more projects and more dollars per city [See Fund Categories A, E, and F]
- the bulk (82%) of the funds go to UAs over 1,000,000 (9% of all the UAs) [B]
- essentially all the rail aid goes to the largest UAs, but the preponderence of non-rail aid also goes to the largest UAs (72%) [C and B]
- transit projects in the large cities tend to be much larger than in smaller cities [D]
- on a per capita basis, larger cities obtain more Federal transit aid [G]
- on a per transit commuter basis, the distribution of funds is remarkably uniform [H, I, J, K and L][1]

Figure 1 illustrates the city-by-city distribution of non-rail UMTA funds on a per transit commuter basis (probably the most viable basis of comparison for most purposes). There is no significant relationship between UA rank and funds per transit commuter (correlation coefficient, $\underline{r}$ = .08;

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[1]Analysis of variance confirms the significance of the relationship between UA size category and the amount of Federal funds received (total funds and per capita). It confirms that city size does not relate significantly to any of the fund amounts (total or non-rail only) on a per transit commuter basis. It should be mentioned that this uniformity does not hold up under some related measures. UMTA's Transit Operating Performance and the Impact of the Section 5 Program (November, 1976) reported that formula grant allocations for UAs under 200,000 were about $0.25 per rider and $0.43 per transit vehicle mile, while these were $0.06 and $0.18, respectively, for UAs over 1,000,000.

Table 1. Distribution of UMTA Funds by Size of Urbanized Area

Fund Category	Total (267 UAs)	Urbanized Areas by Population (Number): Over 1,000,000 (25)	500,000–1,000,000 (21)	200,000–500,000 (58)	50,000–200,000 (163)
A. Number of Projects	2512[b]	574	203	418	626
B. UMTA Funds ($ million)[a]	3850	3150	250	280	170
C. Non-Rail UMTA Funds ($ million)	2498	1805	250	274	170
D. Total Costs (UMTA + Local)/Project ($ million)[c]	4.37	13.29	2.32	2.58	0.48
E. Average UMTA Funds/UA ($ million)	14.41	126.00	11.90	4.81	1.04
F. Average Non-Rail UMTA Funds/UA ($ million)	9.36	72.19	11.90	4.73	1.04
G. Average Non-Rail UMTA Funds per Capita ($)[d]	13.22	29.86	17.21	15.21	9.45
H. Average Non-Rail UMTA Funds per Transit Commuter ($)[e, f]	2.17	1.90[f]	2.23	2.26[f]	2.17
I. Average Section 3 Non-Rail Funds per Transit Commuter ($)[e]	1.44	1.36	1.45	1.49	1.42
J. Average Section 9 Non-Rail Funds per Transit Commuter ($)[e]	0.11	0.09	0.09	0.09	0.12
K. Average Section 5 Non-Rail Capital Funds per Transit Commuter ($)[e]	0.11	0.07	0.16	0.08	0.13
L. Average Section 5 Non-Rail Operating Assistance Funds per Transit Commuter ($)[e]	0.51	0.38	0.52	0.60	0.49

(cont'd)

Table 1 (cont'd)

[a]This analysis primarily uses an UMTA projects tape which includes 2512 projects funded through June, 1977. These total to about \$5.5 billion in UMTA funds and \$11.0 billion total costs. Of the \$5.5 billion in UMTA funds, \$3.85 billion is attributed to specific UAs (and \$1.35 billion of that is for rail projects). Of these, the analyses usually focus on 762 Section 3 projects numbered 0xxx, excluding 6 numbered 7xxx (operating expenses), 5 numbered 8xxx (to UMTA itself), 7 numbered 9xxx (loans), and 1 numbered 0xxx which appeared irregular; 95 Section 5 capital projects and 494 Section 5 operating projects, excluding 1 numbered 8xxx (to UMTA itself); and 1024 Section 9 technical studies. In addition there are 76 Section 16 (elderly/handicapped) grants, 37 Section 23 grants (highway transfers - discussed in the following section of this report), and 4 Section 83 grants (Appalachian Regional Commission funds involved). Categorization as "rail" or "non-rail" reflects our judgment from UMTA tape description.

[b]691 projects were not attributable to a specific UA, based on listed recipient and project description.

[c]This tally reflects allocation of the \$11.0 billion in total costs by UA category; it does not correspond to the various breakdowns of UMTA costs which are aggregated by UAs.

[d]Computed for each UA based on 1970 population, then averaged over the UAs in a size category.

[e]Transit commuters are for each UA based on the percent in the SMSA (standard metropolitan statistical area) who used public transportation to work during census week, 1970, multiplied by the UA population, and by 52 weeks/year. The ratios are computed for each UA, then averaged over the UAs in a size category. Data on transit commuters was missing for 24 cities who received UMTA funding; 23 in the smallest size category, 1 in the 200,000-500 category. Within rounding, categories I, J, K, and L sum to category H. "Transit commuters" does include rail which we exclude from these tallies.

[f]Inclusion of rail funds raises the amount for UAs over 1,000,000 to \$2.37; the amount for UAs 200,000-500, to 2.28.

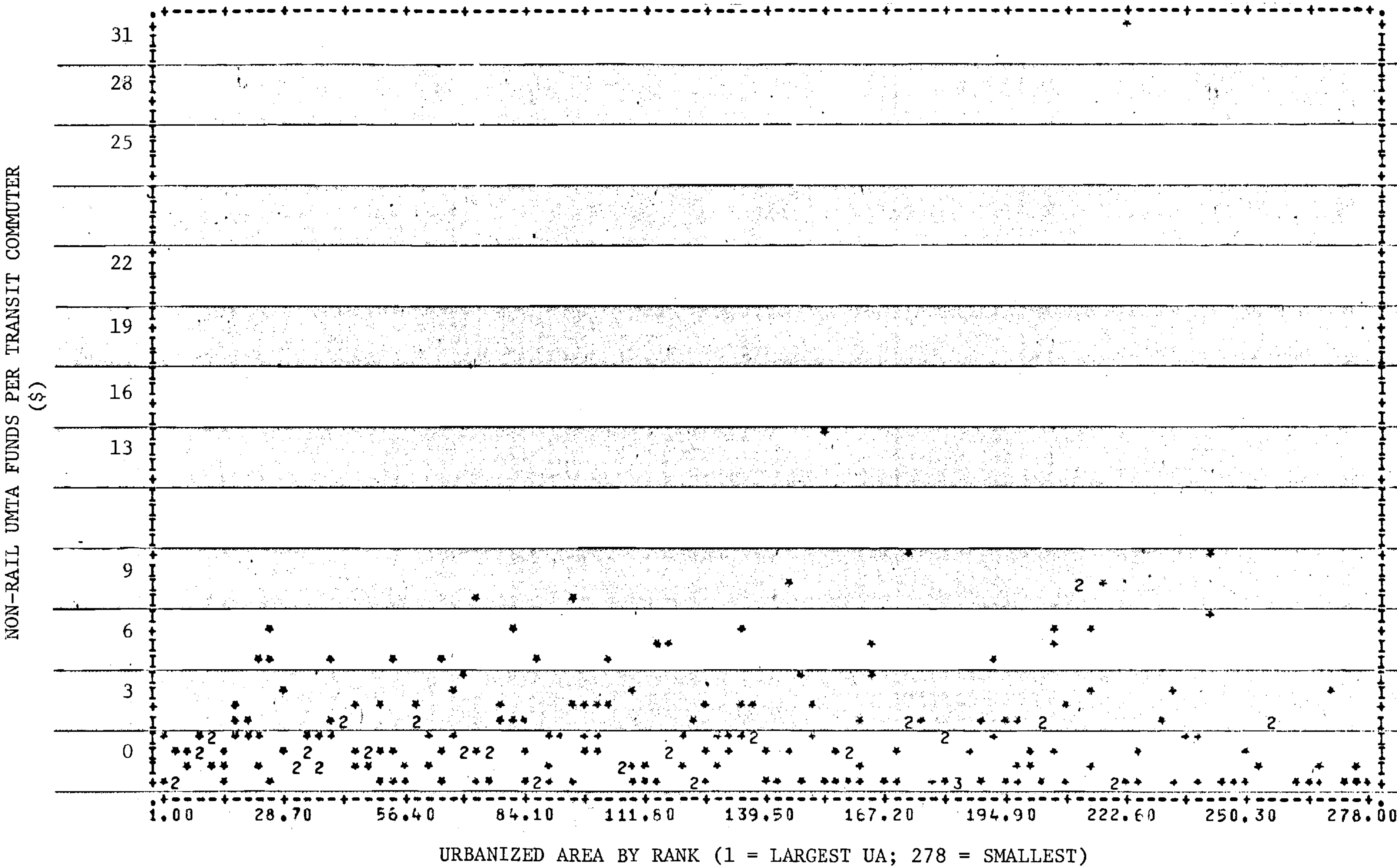

Figure 1. <u>UMTA Funds Per Transit Commuter for Each Urbanized Area</u>

slope, $\underline{\beta}$ = .01). It is interesting to consider the two extremes - those cities which received very large amounts and those which received no such funds at all.

Recalling that the mean is $2.17 per transit commuter (Table 1, category H), we tallied those UAs that received over $5 of non-rail UMTA funds per transit commuter. Twenty-seven UAs comprise this top 10%, of whom none rank larger than twentieth in UA size, and seventeen fall in the smallest category (less than 200,000 population). Interestingly, on a per capita basis, most of these 27 do not rank exceptionally high. Five UAs stood out as high on both per transit commuter (PTC) and per capita (PC) bases:

- Albany, GA ($31 PTC; $157 PC)
- Tallahassee, FL ($8 PTC; $45 PC)
- Atlanta, GA ($6 PTC; $108 PC)
- Honolulu, HA ($6 PTC; $79 PC)
- Denver, CO ($6 PTC; $48 PC)

Albany stands out (see Figure 1) because its $12 million in grants accrues to a 1970 UA population of only 76,512. Most important is the absence of any strong pattern of advantage to a certain size of city.[1]

At the other extreme, 22 cities received no aid at all. All but one of these fall into the smallest size category - UAs under 200,000. Searching for any characteristics that these UAs might have shared, we contrasted them with the 111 UAs obtaining greater than the median $1.74 of total (rail and non-rail) UMTA aid per transit commuter.[2] No obvious explanations emerged. The 22 had a slightly lower percentage of transit commuters than

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[1] This statistical view misses the personnel and management features that can certainly make a difference (e.g., Denver has had an aggressive transit leader).

[2] Median for 221 UAs - 22 others received no aid and 24 lacked transit commuter data.

the 111 (median 2.25 vs. 2.72), but eight of the 22 were above the median for the 111. Their UA population also tended to be lower (median 78,500 vs. 191,000). However, they resided in roughly comparable states in terms of their emphasis on transit, innovativeness, state population, state urban population, and presence of a state department of transportation. And, as cities, they were even a bit better at obtaining Federal support as a percentage of their revenues (median 3.55% vs. 2.44%).

The distribution of the Sections 3 and 9 grants is discretionary (that is, these are made on a competitive project-by-project basis by DOT), while that of the Section 5 funds is by formula (that is, funds are set aside for each UA - 50% based on population; 50%, on population density). It is noteworthy that none of the categories (Sections 3, 5, or 9) show major differences by UA size on a per transit commuter basis (Table 1). An interesting preference within the Section 5 program does appear. Overall, only $56.9 million was devoted to Section 5 capital projects out of $971.0 million total Section 5 funds (6%). For the smallest cities (under 200,000), $8.0 million out of $49.7 million Section 5 funds went to capital projects (16%). In the large, transit-intensive cities, Section 5 funds are devoted almost entirely to operating expenses and they account for only a small portion of the transit budget.[1] Conversely, in the small cities, Section 5 funds represent a substantial increment to the transit budget, and could contribute to the boom in transit operating deficits (given the present arrangement whereby they can be used for operating assistance only to

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[1]This amounts to only 9% for 80 urban areas receiving formula grants, but 24% of the operating expenses for those under 200,000 (UMTA, Transit Operating Performance and the Impact of the Section 5 Program, Washington, D.C., November, 1976).

defray revenue shortfalls).

C. State Influences

While the cities are the basic recipients of Federal transit assistance, they operate in a transportation environment strongly colored by the state government. The actions of the state can affect cities' transit programs through

- provision of matching funds to make up a portion of Federal aid matching requirements
- provision of technical aid and program information
- approval processes - for instance in state department of transportation (or other body) review of transit plans and applications for funding transfers from the highway system, or in "channeling" requirements for Federal funds to pass through the state.

Several transit professionals conveyed the perception that the states made a difference in the response of cities, particularly smaller ones, to Federal transit aid opportunities.

To investigate the role of the states, information was first compiled on the most tangible feature - the provision of state financial aid to localities. Results of two surveys indicate that many states are supporting transit, and the trend is toward increasing support. Carstens et al. in a 1974 survey found 17 states providing some capital assistance and 14 offering operating assistance.[1] In a 1976 survey, AASHTO found 23 states

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[1] Carstens, R. L., Mercier, C. R., and Kannel, E. J., "Current Status of State-Level Support for Transit," Transportation Research Record 589, "Urban Transportation Finance," 1976.

providing capital assistance and 23 offering operating assistance.[1] Despite a few inconsistencies, the two surveys imply that no states ceased to give transit aid and some increased the extent of aid. The strong trend for states to get into transit assistance during this two-year period coincides with the beginning of Section 5 formula grant support to localities. One can at least conclude that states have not reduced their efforts on behalf of transit in the presence of the Section 5 program.

A variety of state characteristics were statistically arrayed against the UMTA fund categories to see if any relationships stood out. Factors investigated included:

- the extent of state matching support for Sections 3, 5, and 9 projects
- indicators of state transportation perspectives (percent of 1971 state transportation expenditures for transit; existence of a state department of transportation)
- demographic measures that appeared potentially relevant to transit support (state urban population; region of the country).

These factors were analyzed in conjunction with measures of the:

- total UMTA aid received (both including and excluding rail) on various bases, but primarily per transit commuter
- Section 3, Section 5 (capital), Section 5 (operating), and Section 9 funds, primarily on a per transit commuter basis
- Dates of first Section 5 grants, or first Section 3 and Section 9 applications.

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[1]American Association of State Highway and Transportation Officials (AASHTO), "Survey of State Aid to Urbanized Areas for Transportation," Washington, D.C., Fall, 1976.

To see if states were chiefly influential on smaller cities, many of the above analytical combinations were also studied for the urbanized areas under 500,000 population (excluding the larger UAs).

In a nutshell, no statistical relationships were documented between any of the state characteristics and receipt of Federal transit grants.[1]

One transit feature that deserves comment is the ceiling placed on the amount any one state can receive. The 1964 act placed a 12 1/2% maximum on capital aid (Section 3). This was switched to a $12.5 million limit briefly in 1966, to a 15% maximum in 1970, and finally removed in 1974. A tally of Section 3 capital improvement aid projects on our UMTA tape through FY73 interestingly shows New York receiving 17.4%; California, 18.4%; Massachusetts, 13.1%; with Illinois close at 11.6%. Following removal of the restrictions, Section 3 aid for FY74 through FY77 tallied <u>less</u> for the three highest states: New York, 14.4%; California, 8.3%; and Massachusetts, 6.2% (with Illinois steady at 11.7%). Apparently, the state ceiling was not a critical factor clamping down aid; however, it should be noted that new alternative funding sources have become available since 1974, probably fulfilling some of the needs of New York and the other states.

D. Time Patterns of Response to Federal Initiatives

In FY65, UMTA Section 3 funds became available for transit capital improvements. In FY67, Section 9 technical study grants were made available. In FY75, Section 5 formula monies became available to localities. This section focuses on the patterns of response by UAs to these opportunities.

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[1] An underlying premise was that the city was the basic unit. Hence, most of the analyses (e.g., analysis of variance) considered urbanized area size in conjunction with a state characteristic. Some results did show a state influence, but these were generally trivial in nature and no consistent patterns emerged.

Based on interviews and observations, we hypothesized that smaller cities might be slower to respond to new Federal transit initiatives. Possible reasons for such a lag include less transit need, less technical capability (e.g., fewer transit planners available), and lower awareness of the new opportunities. To separate out the question of transit need to some extent, several comparisons were performed among only those cities that did obtain aid (under the appropriate UMTA Section).

Results from several analyses converge to support the conclusion that smaller cities do not, on average, respond as quickly. Table 2 shows that larger cities submitted their first grant applications more quickly for both Section 3 and Section 9 funds, and that they received their first Section 5 funds more quickly.[1] Figure 2 illustrates the spread of first application dates for Section 9 funds for the 203 of the 267 UAs that have obtained such funds. The larger UAs tend to respond earlier ($\underline{r}$ = .55). Note that this phenomenon is distinct from the fact that more of the smaller cities do not obtain any funds.

Another indication of a relative response lag for small cities is that they had relatively few of the very early grants. Table 3 demonstrates this effect for the Section 3 grants made through 1966.

From still another angle, Figure 3 shows the profile of first grants to UAs under 200,000. In addition to noting that these cities did not rush to get aboard the transit aid program, it is interesting to observe a burst of activity in FY74 and FY75. The most active fiscal years for beginning to participate in the Section 3 and Section 9 programs immediately followed the increase in Federal matching share from a flexible

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[1]Application and grant dates show very strong correspondence for both Sections 3 and 9, implying that UMTA processing has not favored one category of cities over another. Application dates are rather incomplete for Section 5 grants.

Table 2. Distribution of Average Date of First Grants by Size of Urbanized Area

UMTA Funding Category	Total (267 UAs)	Urbanized Area by Population (Number)			
		Over 1,000,000 (25)	500,000-1,000,000 (21)	200,000-500,000 (58)	50,000-200,000 (163)
Section 3	1970.5 (194)	1967.9 (25)	1970.3 (21)	1970.5 (50)	1971.2 (98)
Section 9	1971.4 (203)	1968.1 (24)	1970.3 (19)	1971.0 (48)	1972.5 (112)
Section 5	1976.2 (183)	1975.8 (23)	1975.7 (19)	1976.1 (45)	1976.5 (96)

Note: Values are the average year of first grant to a given UA, for all UAs in a given size category that received grants (number in parentheses). For Sections 3 and 9, these are first grant application dates; for Section 5, the first date a grant was made. For each Section, the differences among the UA size categories are significant by analysis of variance (respectively, F = 7.5, 26.4, and 14.2).

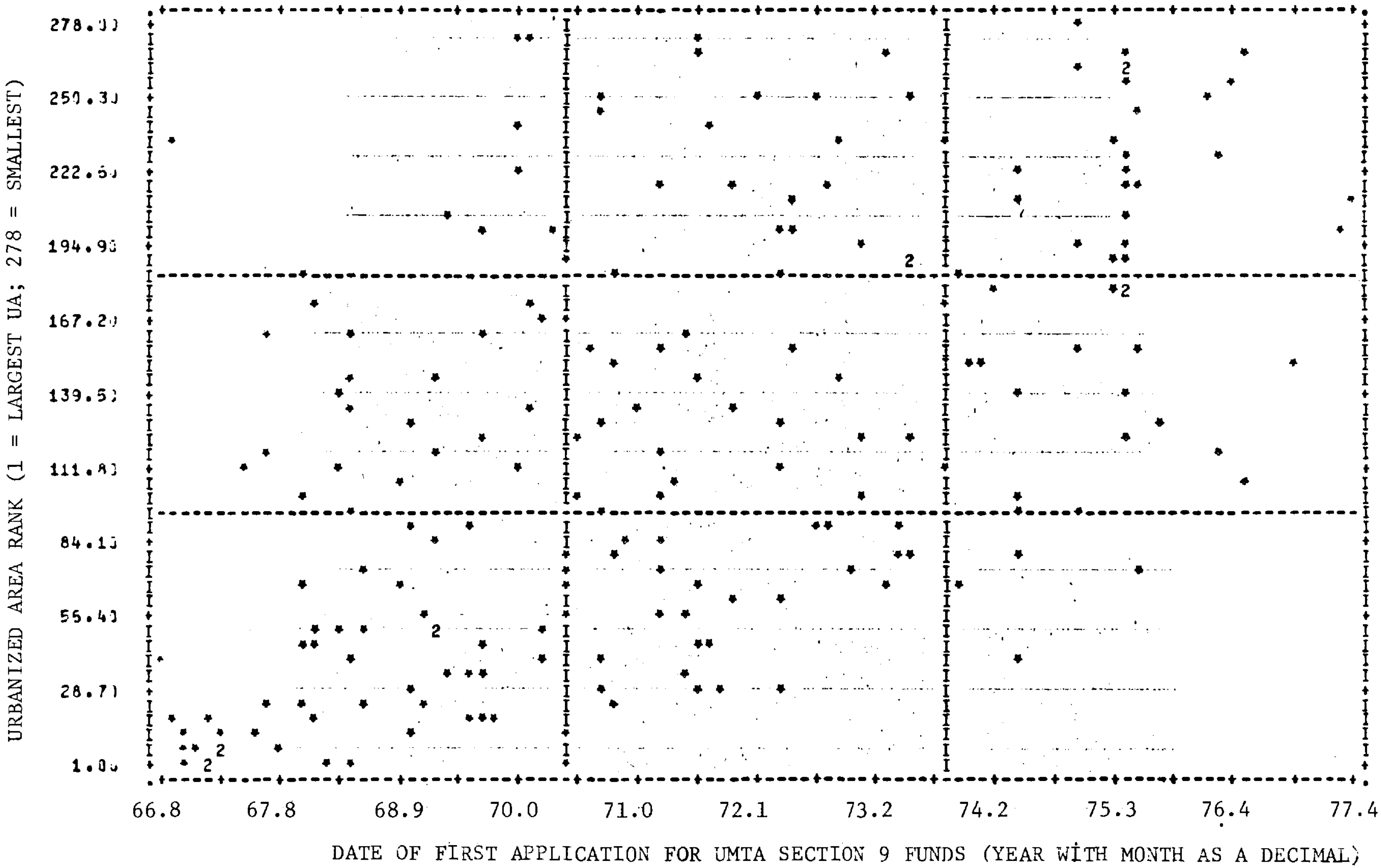

Figure 2. First Application Date for Section 9 Funds for Each Urbanized Area

Table 3. Distribution of the Early Section 3 Projects by Size of Urbanized Area

	Total (267 UAs)	Urbanized Area by Population (Number)			
		Over 1,000,000 (25)	500,000-1,000,000 (21)	200,000-500,000 (58)	50,000-200,000 (163)
Projects Granted, through December 31, 1966	55[a]	24	5	7	11
% of the UAs with at least one Section 3 project	13	48[b]	19	12	7

[a]8 projects were not attributable to specific UAs.

[b]83% of the twelve largest UAs.

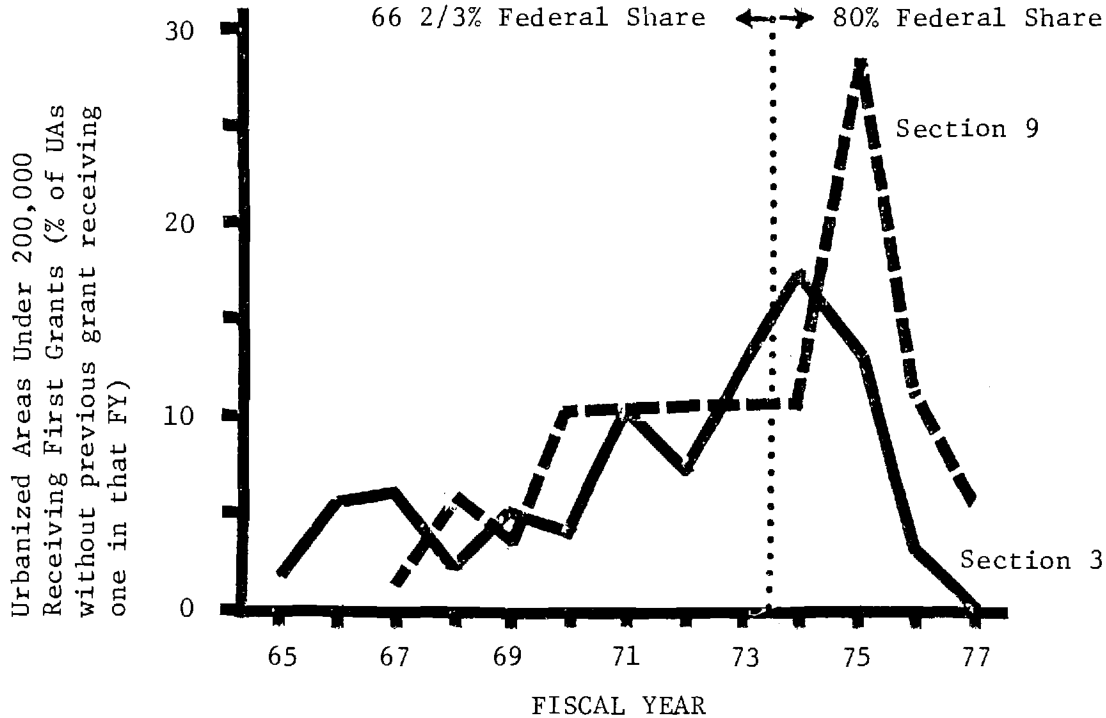

Figure 3. First Grants to Urbanized Areas Under 200,000

66 2/3% to a mandatory 80% in FY74. The number of grants made to these small UAs (whether or not the first to a particular UA) showed a comparable pattern. For Section 3, the number increased from 11 in FY72 and 20 in FY73, to 26 in FY74 and 28 in FY75, then tapered off to 15 in "FY76" and 13 in "FY77."[1] For Section 9, the number increased from 12 in FY72 and 18 in FY73, to 19 in FY74 and 54 in FY75, then continued high at 51 in "FY76" and 59 in "FY77."[1] Smaller cities showed similar gains in the percentage receiving grants and proportionate total and average grant amounts. This is consistent with an interpretation that the reduction in local share required made the transit aid program significantly more attractive for the small cities.[2] Broadened participation in programs is a major rationale for increased Federal share.

III. A Choice of Four

An interesting choice faces the community that wants to obtain Federal aid for a transit capital improvement project.[3] Four sources are potentially available:

1) UMTA Section 3 discretionary funds, available since FY65;
2) Urban System funds, available since FY74;
3) Interstate System equivalent funds, available since FY74;
4) UMTA Section 5 formula grants, available since FY75.

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[1] For comparability, grants were tallied from July through June for 1976 and 1977 despite the change in the Federal fiscal year.

[2] The reason that Section 3 activity peaked in FY74 while Section 9 peaked in FY75 is unclear. A plausible interpretation of the dip in Section 3 activity since FY75 might be that capital needs of the small UAs were now partially met through Section 5 capital grants - up from 1 in FY75 to 11 in FY76 to 26 in FY77.

[3] This section describes the situation through FY78, prior to the Surface Transportation Act of 1978. It will be interesting to see how the new provisions alter local choices.

Each source has somewhat different requirements and constraints. Interstate equivalent funds entail a trade for an Interstate segment; they require state, Federal Highway Administration (FHWA), and UMTA approvals - as do Urban System transfers to transit projects. Most intriguing, these four alternative sources present a variety of matching requirements and implications as to the amount of Federal aid obtainable by a community.[1]

1) UMTA Section 3 funds provide an 80% Federal share (a flexible 66 2/3% prior to FY74);

2) Urban System funds give a basic 70% Federal share, but use of these funds for transit is a substitution for their use on urban highway projects;

3) Interstate funds present a basic 80%, but with loss to the state of that amount of 90% Federal aid;

4) UMTA Section 5 funds can be used at an 80% Federal share for capital improvements or at a 50% Federal share for operating assistance.

One should note that these constitute virtually the full set of attractive options. Public transit capital investment relies almost totally on tax sources.[2] And despite a strenuous UMTA approval process (Mauro notes that it takes at least fourteen distinct steps to buy a bus with UMTA aid), minimal capital investment takes place without Federal aid (from one of these four sources). For instance, in 1972 state and local capital investment amounted to $231 million (U.S. DOT, "A Study of Urban Mass Transportation Needs and Financing," 1974), but according to analysis of the UMTA project

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[1]Note that funding provisions have since been changed by the 1978 Act.

[2]Mauro, G. T., "Mass Transit Regulation: Procedure Governs Substance," Government Executive, November, 1977, pp. 34-38.

tape, the local share on UMTA sponsored projects for that year even exceeded that amount ($278 million). A straight comparison is not proper because the project data reflect obligations, not expenditures. (Expenditures tend to lag by a year or more and were increasing rapidly in the early 1970's.) However, our interpretation is that minimal local funds are invested in capital improvements without Federal assistance. Hence, this is a situation that figures to be highly sensitive to Federal funding structures, unlike the "ABC" highway program where states do so much on their own. So, which do communities choose?

The Federal obligations from the four sources tally roughly as follows for FY74-77:[1]

1) Section 3 - 405 capital grants, for some $1,643,000,000;
2) Urban System - 17 projects, for some $75,000,000;
3) Interstate transfers - 10 projects, for some $640,000,000;
4) Section 5 capital projects - 95 projects, for some $57,000,000.

This strong preference for Section 3 funds is obviously complicated by many factors (eligibility for funds[2], ease of approval, and so on). Nonetheless, there are implications about funding structures to be drawn from the comparison of Section 3 funding with each of the three alternatives.

A. Use of Urban System Funds for Transit

In a study of "Why Urban System Funds Were Seldom Used for Mass Transit" (March, 1977), the Government Accounting Office (GAO) noted, among other possible reasons:

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[1]Tally based on the projects data tape prepared by UMTA for our use.

[2]For instance, in FY75 urban system funds were not eligible for rail assistance.

1) that communities got the most Federal money by using allocated Urban System funds for highways and other Federal funds for mass transit ("competition" between a formula program and a discretionary one);

2) more local money was usually required for a mass transit project funded through the Urban System program (unequal matching ratios).

The evidence is strong that localities have made only minor use of the Urban System funds for transit - an option made available by the 1973 Federal-Aid Highway Act. While about $75 million was going to mass transit in FY74-77, over $1 billion of Urban System funds was obligated on highway-related projects. As the GAO report points out, there are several confounding factors behind this disuse. Yet, there is a strong argument that given a choice between discretionary funds and allotted funds (with other possible uses), a recipient should choose the discretionary funds. In this instance, why take away from allotted funds that can be used to improve urban highways when it is possible to request and obtain additional funds for transit (UMTA Section 3 grants)? Federal policy-makers should not expect grantees to use formula funds when alternative discretionary ones are obtainable.[1]

The second point raised by the GAO is intriguing - given funds available at different matching ratios, how strong is the preference for a lower local share? The use of Urban System funds for transit instead of highways is less attractive to most states and their local authorities. The Federal share at 80% for Sections 3 or 5 is more generous than the 70% for Urban System funds. It is interesting to note that the Federal government adjusts the Urban System matching requirement to reflect the extent of public lands

[1]Heinz Heckeroth of California's DOT noted that transfer was not attractive when Section 3 funds were adequate (personal communication).

in each state. For ten states the resultant increase in Federal share is enough to exceed the 80% for the alternative UMTA fund sources:[1]

Alaska	(95%)	Nevada	(95%)
Arizona	(91%)	New Mexico	(82%)
California	(83%)	Oregon	(86%)
Colorado	(81%)	Utah	(91%)
Idaho	(89%)	Wyoming	(85%)

If matching share were a significant consideration, we might expect to see a preponderance of Urban System transfers in these ten states. Tallying the projects shows some slight evidence to support this interpretation. Despite the fact that most of these ten are not big transit states, six of the seventeen transfers took place in them. Excluding the transfers in New York City, six of the remaining fourteen (43%) for $6.3 million (44%) occurred in the ten public land states. This is by no means conclusive evidence, but it is consistent with the premise that state and local officials take cognizance of small differentials in Federal matching share.[2]

The GAO study notes that the state matching share can be a significant influence, also. For instance, Nevada provides all the matching funds for Urban System highway projects but none for mass transit projects (due to Nevada law restrictions) - a strong inducement for a community to favor "0¢" highway over "20¢" transit projects! Of the eight states which had Urban System projects, six contribute on transit capital improvements. Of the 23 states that used, or planned in the next year to use, highway funds for non-highway (transit) use, 15 (65%) contribute to transit capital matches.[3]

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[1]These figures reflect 1976 Public Land state matching requirements.

[2]One state official we interviewed pointed out that transfers were impeded by the differential 70-30 Urban System vs. 80-20 UMTA Section 3 matching ratios.

[3]AASHTO survey, op. cit.

In contrast, for 24 other states that did not use or plan in the next year to use, highway funds for transit purposes, only nine (38%) provide such aid (no information on the remaining few states' aid provisions). This probably implies that states providing matching aid on transit projects are more favorably disposed toward transit and thus more inclined to support Urban System transit projects, and that the aid itself helps communities opt for transit over urban highways.[1]

B. Interstate System Transfers to Transit

The Interstate fund transfer alternative has not been overly popular - some ten projects in all - one for Philadelphia, two for Washington, D.C., and the rest for Massachusetts (Boston).[2] In terms of matching ratios, the Interstate option trades "10¢" highway dollars for "20¢" transit dollars - clearly disadvantageous. The disuse of Interstate monies for transit is probably most attributable to the perceived need for urban highways. In addition to this, though, the drop from 90% Federal aid to 80% has been noted as a major factor in opposing the shift for Philadelphia's Cobb Creek Expressway.[3]

C. Section 5 Funds: For Capital or Operating Expenses?

Turning to the distribution of Section 5 grants, it is noteworthy that the Section 5 capital grants ($57,000,000 on 95 projects) are only about 6% as much as the Section 5 operating grants ($914,000,000 on 494 projects).

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[1] Note, however, that the analysis of state matching provisions failed to show any clear relationship to the extent of cities' participation in Federal aid transit programs.

[2] This is consistent with Alan Altschuler's personal observation that the Interstate provision was adopted at Massachusetts' urging; that they made real use of it to save Federal aid funds for Massachusetts that would otherwise have been lost; and that, despite popular attention to "busting the Highway Trust," the provision has been of minimal significance to other states.

[3] Sims, D., Pennsylvania DOT, personal communication.

This is despite a sizeable differential in required local match - 50% for operating assistance versus 20% local share for capital improvements. As in the case for Urban System fund transit use, it would appear that grantees find it advantageous to apply for available discretionary funds, rather than use their formula funds which have alternative uses.[1] Or, it may be that operating budgets are a higher priority and there are insufficient local funds available for capital improvement. The issue of Federal operating assistance is a highly controversial one. Local demands for more Federal operating aid have risen along with operating deficits. There is concern that the Federal operating assistance has encouraged operating deficits. It is clear that recipients are not sensitive to matching share when it comes to accepting operating assistance in lieu of capital assistance.

IV. Implications of Federal Transit Funding Structures

A. Overarching Factors

Federal funding programs do not affect all potential recipients in the same way. A variety of influences interact with each Federal aid program to determine its effects. These include the characteristics of the potential recipients, the economic climate, and the societal priorities of the moment. Short of lamenting that each case is unique, it seems useful to distinguish certain key factors that seem to play a prominent role in determining the responses to Federal aid programs.

The first of these might be labeled dependence on Federal aid. Quite logically, if aid recipients come to depend on a particular program, they will be more sensitive to changes in program policies. For example, as

[1] Efforts by UMTA to shut off Section 3 aid when Section 5 funds were available to a city have apparently not been very successful.

noted earlier, very little transit capital investment takes place without Federal aid. Hence, one would expect local authorities to be more affected by changes in transit capital aid programs, than would be most states by changes in highway capital aid parameters (since the states muster considerable capital investments over and above the Federal highway program).[1] This factor may dominate the character of certain matching requirements. If a Federal aid recipient routinely invests more than is required for Federal support ("overmatches"), changes in matching requirements may be inconsequential. The Federal-Aid Primary Highway program and Section 5 transit operating assistance exemplify this. In such situations, programs that are defined for use only on specific categories (categorical programs) may behave like unrestricted block grants because they do not affect local priorities.

A second overriding factor is the potential recipient's <u>ability to respond</u>. This may concern time, information processing, or trained manpower constraints that preclude a response to a Federal aid opportunity. Most commonly the constraint is money. As described previously, smaller cities seemed more apt to respond to Section 3 and Section 9 opportunities when the required local share dipped from 33 1/3% to 20%. For example, arguments that local communities could not raise their matching share supported the increases in Federal aid for smaller airports being increased from 50% to 75%, then to 90%.[2] Fiscal constraints on state highway program funds associated with the reduction in gasoline tax revenues with the 1973 energy crisis and super-inflation on construction threatened long-standing Federal aid construction programs. As we move to consider the implications of funding structures, it is well to remain aware of these overarching influences.

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[1] States vary considerably in this regard; for instance, Colorado has no non-Federal-aid state road system.

[2] Reduced to 80% for [illegible] and FY80.

B. Categorical vs. Block Grants

What is the purpose of having a categorical aid program? Presumably, it must be to stimulate effort in an area of national priority, perceived to be of lower priority by the potential aid recipient. The Sectional UMTA grants have fostered specific sorts of activities - e.g., facilities for the elderly and handicapped, and planning. The capital programs may have induced capital investments in preference to operating costs - bus purchases in 1974-1975 were approximately double what they might have been absent the Federal subsidy.[1] UMTA grants have stimulated rail systems investment (63% of UMTA capital aid through 1976 went to rail). One reason is that capital represents up to 80% of the total cost of rail operations compared to less than 10% for buses. So, an 80% capital grant reduces the overall cost of rail systems by 64% to the recipient, versus about a 7% reduction for bus systems.[2] We can conclude that the UMTA capital grants favored capital investment in preference to maintenance and operating outlays, and rail in preference to bus.

Many transportation people would agree with the conclusion of John Wells et al. that it is desirable to minimize the Federal influences constraining local decision-makers in the absence of a clear-cut national objective.[3]

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[1] Charles Rivers Associates, Inc., Subsidies, Capital Formation and Technological Change: Mass Transit, prepared for Experimental Technology Incentives Program, National Bureau of Standards, Washington, D.C., November, 1977, p. 177.

[2] Ibid., p. 175.

[3] John D. Wells et al., An Analysis of the Financial and Institutional Framework for Urban Transportation Planning and Investment, Institute for Defense Analysis, Arlington, VA; prepared for Office of the Assistant Secretary for Policy, Plans, and International Affairs, U.S. Department of Transportation, June, 1970 (PB 265 245).

Indeed, we seem to be in the midst of a trend away from categorical to block grants.[1] If national objectives are not a dominant consideration, the objection to block grants seems to be that the increased local flexibility might lead to confusion![2] But what is their purpose? Presumably, it is to substitute for local funds. This makes redistribution the primary issue - who benefits and who pays? Setting aside user/non-user distinctions, why should the nation as a whole pay for intra-city transportation? One might well ask about the distribution of UMTA block grant funds vis-à-vis the distribution of general revenue sources that support them. (At this time, the Section 5 funds act like a block grant.[3])

Indeed, one can take the argument a step further to say that if the local government needs financial aid, why not allow it free rein to set priorities, not limiting those to transportation. Why should Atlanta build a subway system at national expense when it would not choose to do so with $2 billion of its own funds? Broadly speaking, several degrees of categorization can be differentiated:

- specific categorical transit programs (e.g., Section 16)
- transit block grants (e.g., Section 5)
- urban transportation block grants (e.g., proposed easing of interchange between urban highway and transit uses)
- total block grants (e.g., general revenue sharing).

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[1]However, extremes of categorization continue - the 1974 Federal-Aid Highway Act Amendments included an appropriation for a specific intersection in a specific city. [W. M. Hilliard notes this in Transportation Research Board, Special Report 157, Transportation Programming Progress, Washington, D.C., 1975.]

[2]Transportation Research Board, Special Report 155, Research Needs for Evaluating Urban Public Transportation, Washington, D.C., 1975.

[3]Congressional Budget Office, Urban Mass Transportation: Options for Federal Assistance, Washington, D.C., February, 1977, p. 37.

The key dimension is the tradeoff between stimulation (categorical programs) and substitution (block programs).

C. Matching Requirements

Matching shares also strongly relate to the question of stimulation versus substitution. At one extreme is the possibility of a Federal grant without any matching requirement. These can either be categorical (e.g., certain 100% Federal aid safety programs) or block (e.g., revenue sharing) - the former stimulate effort on a particular program, but without local outlay; the latter, largely substitute for local outlays. Toward the other extreme, programs with relatively low Federal share are unlikely to be very attractive to potential participants. However, an interesting effect intercedes in the middle-to-high Federal share range. The greatest stimulation of local program investment may occur with moderate Federal shares (e.g., 50% Federal share induces equal recipient investment). Very high Federal shares lose their leverage to stimulate appreciable local investment (e.g., 90% Federal programs induce the recipient to invest only 10¢ of the total dollar). As noted previously, high Federal share may enable fiscally-strapped parties to participate.[1]

It is worth emphasizing that the matching ratio acts in conjunction with other program and situation factors. Urban System and Interstate transfers to transit seem quite dependent on small matching differentials, but Section 5 recipients allocate most of these formula funds to operating expenses at 50% match in preference to capital investments at 80% Federal share. However, in the Section 5 instance, most cities do not have to

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[1]As discussed in the Overview paper of this study, response to Federal funding programs also depends significantly on the fiscal capability of potential recipients.

spend any more than they would have absent the grant.[1,2] Hence, these act as block grants without matching requirements.

D. Discretionary vs. Formula Grants

In considering this dimension of Federal aid structuring, it is crucial to realize the manner in which Section 5 formula grants are confounded with a non-matching, block grant character (as discussed in the previous paragraphs).[3] Formula programs apportion funds on a prescribed basis (e.g., based on population and population density for Section 5), whereas discretionary grants must be applied for on a project-by-project basis.

Discretionary funds best suit "lumpy" situations - non-routine, large projects such as the construction of new heavy rail systems. One of the key concerns is the equitability of distribution. While this is always subject to debate, our analyses indicate a remarkably even distribution of Section 3 and Section 9 funds (and also Section 5) on a per transit commuter basis. (One could argue that this favors the status quo, i.e., the older, Northern cities with established rail systems. An alternative strategy would be to provide more aid to the newer, Southern cities which are having greater population growth and might benefit greatly from stimulating new transit efforts.)

A main advantage to formula allocations is their relatively assured nature. This eases the uncertainties of planning and can have beneficial

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[1] Subsidies, Capital Formation, and Technological Change: Mass Transit, Charles Rivers Associates, op. cit., p. 70, 82.

[2] Indeed, all but 6 of the 46 UAs over 500,000 population overmatched according to UMTA, Transit Operating Performance and the Impact of the Section 5 Program, Washington, D.C., November, 1976, p. 10.

[3] In contrast, note the Federal-Aid Highway Program - a formula program with some operationally effective matching demands and categorical features.

secondary effects. For one, state and local transportation people recognize their own job security as greater in association with the reliable highway program than with the transit program. Another advantage of formula programs is their simplified administration, not having to determine who is to receive what grant amounts.

E. Long Term Surety

Beyond the formula consideration just mentioned, the assurance of program support for an extended period is most strongly linked with the trust fund concept. Hilton has called this a key to the prospects for transit.[1] A key point of contention, beyond that of the desirability of a trust, is whether it should be unified with the highway trust. Our evidence on these issues is very limited. To date, options for use of highway program funds for transit have not caused a serious drain on highway resources. Dangers of a drainage in the other direction, from transit to highways, in the event of a combined program are perceived as serious by at least some professionals. On the other hand, there appears to be a strong consensus that long term assured support would be a major asset to transit development.[2] The effects of extended term Federal aid commitments, beginning with the 1970 UMTA Act, are unfortunately confounded with increased levels of support and changes in funding structures.

F. Hybrids

Briefly, it should be obvious that the discussions of funding structures have focused on the "ideal types." In practice, these interact strongly with each other. Also, it is quite feasible to design funding

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[1]Hilton, G. W., Federal Transit Subsidies, American Enterprise Institute for Public Policy Research, Washington, D.C., 1974, p. 11

[2]Alan Altschular personally argues that a trust fund is evidence of public support, no more and no less.

policies which capture desirable features of categorical and block grants, and discretionary and formula programs - as well as variable matching and support period features. Present and proposed Federal transportation policies do this to a significant extent.

G. Funding Structures vis-à-vis Public Transportation Objectives

Manipulation of Federal funding structures should never be an end unto itself. Even arguments about simplification or standardization (e.g., making a whole series of matching requirements the same) make no sense on their own. Transportation programs and financial aid arrangements should be based on goals and objectives; the financial structures are only a means to those ends. The proper context is obviously to specify the objectives first, then to manipulate the funding and other program factors to attain those objectives.

What then are the goals and objectives of the Federal urban transportation effort? Drawing upon legislation, policy statements, and the views of various transportation parties, Table 4 lists candidate goals for public transportation (mass transit and public paratransit).

Possibly the toughest question is how to measure performance. Explicit indicators of goal-attainment are largely lacking and basic data on transit activities are very weak (the Section 15 reporting system now in place may help considerably). The evaluation of how the various funding structures have supported the goals and objectives is outside the scope of this research. Our intent is to indicate, to the degree possible, what the effects of the individual funding structures are; evaluation of composite funding policies is a different question. However, Table 4 sketches out some general implications of various funding structures vis-à-vis the goals and objectives. The goals/objectives are

Table 4. Some Possible Interactions Between Type of Funding Structure and the Public Transportation Goals and Objectives

Goals and Objectives	Funding Structures: Categorical vs. Block Grants	Matching Share	Discretionary vs. Formula Grants	Long Term Assured Funding
1. Aid the Transit Dependent	Certain categorical programs address directly (e.g., Section 16 aid to elderly and handicapped). Block grants tend to maintain lower fares and service.	A moderate matching share most stimulates increased local transit investment.		
2. Provide Efficient, Economic, Convenient Transportation	Categorical programs lead to inefficiencies.	A moderate matching share most stimulates increased local transit investment. Differential matches distort priorities.	Formula grants do not optimally match needs.	
3. Decrease Auto Usage	General transportation block grants could further auto interests. Categorical transit grants are not likely to be the most effective or efficient means to this end.			Long term assured transit funding could reduce a possible pro-highway bias.
4. Foster Planned, Concentrated Urban Development	Categorical grants are antithetical to local planning.	Differential matches distort priorities.	Formula grants facilitate planning. There is a question as to whether current allocations favor urban development.	Long term assured funding facilitates planning.
5. Maintain Transit Service				Long term funding is an asset.
6. Population Distribution Patterns	Present categorical Section 3 program favors rail and, therefore, large, Northern cities.	High Federal matching share favors increased participation by small cities and those with limited funds.		
Miscellaneous Objectives	Block grants allow local decision-maker flexibility, more likely to lead to allocation to attain greatest net benefits (as perceived locally), simpler to administer.	Differential program matching requirements cause distortions in local priorities, not likely to yield greatest net benefits; high Federal shares politically attractive.	Formula grants offer greater predictability of funding, but may not allocate according to greatest need/benefits; they ease administration.	An objective in itself; politically attractive.

brought together again with the funding structures when we consider the implications of current policy proposals in a later section.

H. Indirect Effects of Transit Funding Structures

The implications of transit funding programs extend beyond the public transportation goals and objectives just discussed. Effects are difficult to attribute in any simple fashion to a particular funding program, yet several provocative observations can be made:

- public ownership: the capital grants (Section 3) stimulated public takeover of ailing private transit firms.

- fare stabilization: public ownership and the formula (Section 5) grants contribute to low fares.[1]

- capital formation: the capital grants stimulated large increases in both rail and bus capital investments in the first half of this decade. This is primarily for construction in new rail systems and for vehicle replacement for existing rail systems and bus systems. Most new technologies are designed to improve the quality of service, not to reduce costs.[2] New rail systems, in the short run, have proved to be expensive, incur large operating deficits, offer little energy conservation, and have little impact on automobile usage.[3] The capital grants have promoted increased numbers of competitors in the bus manufacturing industry.

- increased wages: public ownership appears to have contributed to wage escalation. From 1967 through 1975 annual earnings of transit employees rose 21% faster than the general price level (as measured by the GNP deflator) to become the highest of any public sector group.[4]

- productivity decline: labor productivity, as measured by the ratio of either vehicle miles or passenger trips to number of employees, has fallen since expansion of the capital grants program in the

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[1] Average transit fares have decreased in constant dollars since 1972, according to the American Public Transit Association, op. cit., p. 32.

[2] Charles Rivers Associates, op. cit.

[3] Congressional Budget Office, Urban Mass Transportation: Options for Federal Assistance, Washington, D.C., February, 1977, p. xii.

[4] Charles Rivers Associates, op. cit., p. 96.

> 1970's. Capital has not substituted significantly for labor.[1] The formula grants program also provides disincentives for efficient operations. Subsidy of operating deficits has led to maintenance, or extension, of service (with no substantial ridership boosts), and low fares (or reduced taxes).[2] Restriction of funds to public authorities (they can pass funds through) helps to limit competition from innovative private firms. Further, most opportunities for productivity increases in transit lie in system design and management. Federal aid programs not only do little to promote this, their labor protection requirements inhibit such actions.[3]

A serious problem in judging public transportation funding programs is the lack of means to evaluate their effects. In terms of the direct goals, the lack of operational criteria has been singled out as a major problem.[4] In terms of goals, objectives, and other effects, the absence of good information is a problem. It is not surprising, therefore, that cost-effectiveness concerns have not been paramount.

V. Some Observations on 1978 Legislative Proposals

The proposed Highway and Public Transportation Improvement Act of 1978[5] addresses many of the funding issues raised herein. The purpose of this discussion is not to pass judgment on the Act, but rather to relate the foregoing analytical implications to it. In so doing, the emphasis is on urban public transportation and Federal funding structures. This discussion is not intended to be comprehensive. Several features of the Act are treated, one-by-one.

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[1] Union work rules and Federal provisions are a factor here. In terms of capital itself, cost-effectiveness is not tested because of the 80% Federal share which means that additional vehicle features need be worth only 20% of their cost to the local buyer to be attractive. (Ibid, p. 180).

[2] Congressional Budget Office, op. cit., p. xiii.

[3] Charles Rivers Associates, op. cit., p. 181, 182.

[4] Transportation Research Board, Special Report 155, op. cit.

[5] Contrasts between the proposals discussed and the since enacted 1978 Surface Transportation Assistance Act remain interesting; hence, this discussion has not been removed.

Uniform 80% Federal Matching Share. This serves to remove the differential program matching shares, except for the Interstate Highways. One implication should be local choices based more on perceived needs and priorities than on maximizing Federal aid. Transfers of Urban System and Interstate funds to transit projects should be facilitated, although matching differentials are only one factor presently limiting these. Indeed, since Interstate transfers will be entitled to 90% Federal aid (from general revenues), they will have an edge over other sources of transit capital aid. Because of this and the greatly reduced availability of discretionary UMTA capital funds (Section 3), it seems likely that increases in transfers to transit could result. Given the present limited utilization of Interstate and Urban System transfer funds for transit, that does not seem unreasonable.

While the 80% Federal share represents no change for transit, it is a high matching level. This tends to encourage broad participation (i.e., by smaller UAs with less local money available for matching requirements). However, it also provides little incentive for cost-effective decision-making given that a project that is worth over 20¢ on the dollar is locally attractive. It also yields low leverage to stimulate transportation investment. Given the general absence of significant transit investment over and above that required to meet Federal matching requirements, a lower matching share would prompt considerably more overall effort. For instance, in the absence of local overmatching, 80¢ of Federal aid generates $1.00 of total investment at this matching ratio. In contrast, at a 50% ratio, 80¢ of Federal aid generates $1.60 of total investment (i.e., 60% more transportation effort).

Changes in Formula. The proposed formula entails several changes:

- operating aid limited to 33 1/3% of expenses instead of 50% of deficits, and to 60% of the non-population apportionment factor amount;

- no maintenance of effort provision;
- apportionment based on commuter rail miles (5%), fixed guideway route miles (19%), and bus replacement factor/ratio of number of bus seat miles in prior fiscal year (25%) in addition to population (25 1/2%) and population weighted by density (25 1/2%);
- four years in which to obligate funds.

The new operating aid limits are strongly supported by the present analyses of the effects of the old limits. They remove the incentive for operating deficits and replace the previous differential matching ratio incentive to use formula funds for transit capital investments, which did not work (94% of Section 5 funds have gone to operating expenses). Removal of the maintenance of effort provision is reasonable given that it was largely ineffective in the face of inflation-induced increases anyway.

The apportionment formula change would favor maintenance of the present commuter systems (i.e., old, large, Northern city systems) relative to stimulation of new ones. Our "per transit commuter" analyses indicate no serious problems with the old formula, although other measures (such as per capita or per 1974-75 revenue riders) show favoritism to the small UAs without extensive transit systems.[1] One's preference depends upon whether a dominant goal is to boost transit use in the growing areas without much transit usage, or to aid the older cities maintain transit service.

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[1] Some argue that the present system thereby fails to provide adequately for existing transit systems.

The four-year obligation period along with the formalized letters of intent provides better long-term funding flexibility and assurance. This is conducive to sensible planning. Given that routine capital expenses are to come out of the formula program, the four-year period certainly makes sense to give local authorities the ability to accumulate aid for sizable investments.

Reduced Use of Discretionary Funding. As just mentioned, the proposal calls for use of discretionary transit aid only for exceptional capital investments. This should ease the UMTA administrative chores and red tape facing local authorities seeking aid for routine capital investments (e.g., bus replacements). It may make things easier for the small cities who seem most sensitive to program complexities. The corresponding increase in the formula program means more reliable funding prospects which are helpful in planning. Most importantly, this change reduces the incentive for over-capitalization (in lieu of maintenance, etc.).

More Flexible Highway-Transit Fund Interchange. The provision for up to 50% transfer in either direction (highway to transit or transit to highway) transforms the transportation aid program toward a block grant program, away from a categorical one. The 1973 provisions for Interstate and Urban System transfers to transit have not caused damaging fund losses to the highway program. However, as discussed, there have been a number of factors limiting use of the transfer provision (including differential matching requirements). The stronger case for concern of the proposed flexibility might be that from transit to highway. Besides tending to counter the urban transportation goal of decreasing auto use, it may subject the funds to unequal lobbying forces inclined toward highways. On the other hand it favors the objective of minimizing Federal constraint on local choice processes. In a similar fashion, the proposals to consolidate Section 9 funding into a composite transportation planning category and to combine UMTA and FHWA are intriguing. These proffer prospects of reduced modal rivalry and long-term equalization of professional capabilities in areas such as planning. But, they raise fears about "swamping" the less-robust transit institution by its stronger highway counterpart.

Overall. In terms of simplification and rationalization of Federal funding structures, the proposed Act is very attractive. It would push the aid program in the direction of a formula, block grant program. In so doing along with equalizing matching ratios, it would reduce the Federal programmatic influences, thereby enhancing decision-making to meet locally perceived priorities. In other words, the Federal role would become more that of subsidizing local public transportation efforts than that of stimulating efforts in particular programs.

Insofar as one sees the supposed Federal goals and objectives for transit (see Table 4) as rather vague, this is a highly desirable direction to go. One can then focus on distributional issues: What is the most equitable way to support public transportation? Who should pay and who is benefitting? What should the Federal involvement be?

On the other hand, to the extent that one ascribes to the sorts of goals enumerated for public transportation, analysis should focus on the implications of the proposed changes for attainment. In most general terms, the changes bode well for efficiency and meeting transit needs as those are perceived by local authorities. They imply less of a Federal incentive toward transit investment per se (stimulation of effort) and toward transit in lieu of auto usage.

These issues deserve serious analytical attention in conjunction with policy deliberations. Analyses could be helpful in weighing the "net effects" of the Act's composite of funding structure changes. Policy attention to the relative importance of the national public transportation goals and objectives is needed to weigh the desirability of the likely effects of the proposed changes.

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX B

HIGHWAY MATCHING REQUIREMENTS AND FUNDING LEVELS: A PRELIMINARY MODEL OF STATE RESPONSE

by

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Prepared for

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16. Abstract
This study describes the patterns of Federal and State highway expenditures from 1950 through 1975. Interesting findings include a trend of decreasing Federal and State levels of support for highways (in constant dollars), increasing emphasis on the ABCD (Primary, Secondary, Urban Extensions, and Urban System) highways relative to the Interstate, and a trend toward increasing maintenance expenditures. Significant dispersion among the States is demonstrated on such measures as user tax rates and per capita tax burden. This work is part of a broader study that addresses the effects of differential funding structures across highway, airport, and transit modes.

The report is structured with each of the discrete analyses available separately as follows:

Appendix A, Mass Transit
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

	page
Summary	iii
I. Introduction	1
II. Overview: Patterns of Highway Expenditure Over Time	1
A. Scenario: The Federal Perspective	2
B. Scenario: The State Perspective	4
C. Scenario: The Taxpayer Perspective	11
III. Key Variables	15
A. "Program Effect"	16
B. Fiscal Capability	16
C. Needs	20
IV. Exploration: Impacts of the FY 1974 Matching Ratio Change	27
V. Conclusions and Areas for Further Exploration	33

Summary

The purpose of this research is to understand (and later be able to predict) states' responses to changes in Federal transportation funding policies. In particular, this analysis focuses on state responses to Federal highway matching requirements and funding levels. Both the behavior of and interaction between the Interstate and ABCD[1] systems are examined. Ultimately, this work should be useful in analyzing Federal policies as well as states' responses.

This effort is part of a broader study for the Office of the Secretary (P. J. Barbato, monitor). The larger study addresses the effects of differential funding structures across highway, airport, and transit modes.

The approach undertaken to meet the stated purpose is as follows:

1) Obtain a general overview. This is pursued from three vantage points (the Federal, state, and taxpayer perspectives).

2) Postulate the key factors (variables) influencing state response.

3) Explore the implications with respect to a particular policy change - the 1970 Federal Aid Highway Act.

4) Re-explore, as necessary, and draw conclusions.

The salient conclusions may be summarized as below. First, from the general overview, looking at the period from 1950 on,

<u>from the Federal perspective</u>:

- In current dollars[2], Federal aid has increased with time.
- In constant dollars[2], Federal expenditures have actually been decreasing since 1965.
- If an extrapolation of the expenditure trends of the past ten years can be believed, the ABCD highway program will soon have equal emphasis with the Interstate program.
- The Federal government has invoked level and matching requirement initiatives to change state response. These include the 1956 Federal Aid Highway Act establishing the Interstate System and the 1970 Federal Aid Highway Act changing the ABC matching ratio, effective fiscal year (FY) 1974.

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[1]ABCD refers to the combined Federal-aid primary (A), secondary (B), urban extension (C), and urban (D) systems.

[2]All dollar values in this paper are in current dollars unless specifically expressed as constant (or deflated) dollars.

from the state perspective:

- States obtain their highway revenues primarily from highway user taxes, with Federal government funds second in importance.
- In current dollars, the states have increased their level of expenditures over time almost linearly.
- In constant dollars, state expenditures have been decreasing since about 1970.
- In both current and constant dollars, the proportion of the state budget expended on highways has been dramatically decreasing since about 1965.
- ABCD expenditures account for a steady two-thirds of the states' own expenditures over the period 1955-1975; a decreasing percentage of Interstate funds has been replaced by increasing non-Federal system expenditures.
- States currently lay out four to five times the amount of state-only capital on the ABCD program as on the Interstate system.
- For every five dollars spent on highways, more than one dollar goes to maintenance. The trend is to even more on maintenance.
- The states project their 1990 needs to significantly exceed present expenditures. Thus, optimum system performance is not obtainable.
- No big shift in state expenditures occurred in 1974 or 1975 as a result of the Federal initiative in FY74.

from the taxpayer perspective:

- Highway user taxes, expressed in constant dollars, were fairly constant from 1955 to around 1968, but they started dropping at that point.
- Among states there is wide dispersion in the amount of state user taxes.
- Equity measures such as per capita tax burden, miles of travel per dollar tax burden, and per capita bond indebtedness also show dispersion across the various states. Different states "suffer" according to the measure of equity chosen.

Continuing with the second step of the approach, key variables were postulated to be "program effect," state perceived need, and fiscal capability. (Here "program effect" reflects factors such as matching ratio, anticipated Federal funding commitment, and the state's last-year expenditure level.) Existing data (from the 72 NTR[1], 74 NTR[2]) were exploited as needs measures: in all, three different needs measures were utilized. In addition, two separate measures of fiscal capability were employed: survey results from the 72 NTR, and percent state dependence on Federal aid. After this study was essentially completed, we became aware of new fiscal capability work by Cooper[3], and new needs measures.[4]

Exploration centered around three aspects of the 1970 Federal Aid Highway Act. First, the states' historic ABCD matching tendencies were related to fiscal capability; these tendencies were then compared with the states' priority preference between the ABCD and Interstate systems. It was found that fiscally self-reliant states are "builders" (historically exceeding their matching requirements), whereas the more dependent states (less fiscally capable) just meet their matching requirements (i.e., they are "matchers"). Moreover, it was found that ABCD "matchers" reflect other highway priorities than ABCD (such as Interstate). The second aspect of exploration considered whether or not the 1970 Highway Act (which increased matching ratios) resulted in a substantial change in state priorities. As expected, no such change was found. The third arena of investigation involved the prediction of state program expenditure levels across the matching ratio change. These state-by-state predictions were based on "common sense" expectations depending on whether or not a state was more or less needy and more or less fiscally capable. These predictions failed, being confounded by funding intent and the weak needs and fiscal capability measures available.

Enhancements of the model likely to result in increased evaluative and predictive success include: using the fiscal capability classification suggested by Cooper, replacing our needs measures with one based on The Status of the Nation's Highways: Conditions and Performance, and explicitly incorporating funding intent of a given policy into the model. It is recommended that these changes be pursued as the next step toward completing "A Model of State Response."

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[1]U.S. Department of Transportation (DOT), 1972 National Transportation Report, Washington, D.C., July 1972.

[2]U.S. Department of Transportation (DOT), 1974 National Transportation Report, Washington, D.C., July 1975.

[3]Cooper, Thomas W., The State Highway Finance Outlook, U.S. Department of Transportation, Washington, D.C., December 1978.

[4]U.S. Department of Transportation (DOT), The Status of the Nation's Highways: Conditions and Performance, Washington, D.C., September 1977.

I. Introduction

The purpose of this research is to understand (and later be able to predict) states' responses to changes in Federal transportation funding policies. In particular, this analysis focuses on state responses to Federal initiatives in the form of highway matching requirements and funding levels. Both the behavior of and interaction between the Interstate and ABCD[1] systems are examined. Ultimately, this work should be useful in analyzing Federal policies, as well as states' responses.

This effort is part of a broader study for the Office of the Secretary (P. J. Barbato, monitor). The larger study addresses the effects of differential funding structures across highway, airport, and transit modes. We deeply appreciate the insights offered on current and future policy issues by the many knowledgeable transportation professionals acknowledged in our overview report.

The approach undertaken to meet the avowed purpose is first to obtain a general overview. This perspective is pursued from three distinct vantage points: that of a Federal, state, and taxpayer viewpoint. Insight garnered from the overview is then utilized to postulate the key variables influencing state response. This is followed by exploration of implications of the FY 1974 highway policy changes and conclusions.

II. Overview: Patterns of Highway Expenditure Over Time

Our interest lies in understanding the past effects of Federal funding policies so as to be able to anticipate likely effects of contemplated changes in these policies. It is toward this objective that we examine

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[1] ABCD is our notation for the combined Federal-aid primary (A), secondary (B), urban extension (C), and urban (D) systems. We must look at the aggregate to maintain consistency in the data series.

the relationships between Federal funding parameters and state responses in the next section. The first step in this direction entails a description of the past patterns of highway expenditure behavior. We approach these from three distinctive vantage points - those of the Federal government, the states, and the "taxpayers." The first aims to visualize the pattern of Federal highway funding actions over the past twenty-five, or so, years. The second reflects the funding changes in respect to the states' own contributions. The third presents some basic equity issues with bearing upon the conceptualization of policy points of concern.

A. Scenario: the Federal Perspective

We first examine the question of Federal expenditures since 1950. Figure 1 shows a plot of current dollar[1] average Federal highway expenditures per state versus time. As may be seen from this figure, Federal expenditures have increased over time, with a large jump in 1956 or 1957 with the inception of the Interstate system program. Figure 2 shows the same data corrected for inflation (using the Consumer Price Index - CPI - with 1967 as base); here we see (in deflated dollars) a rising Federal commitment through the 50's and a slowly declining level over the past decade. When one considers that highway construction costs have been inflating at an even greater rate than the CPI, one can see the challenge facing highway administrators at all levels of government.

Figure 3 shows the relative Federal commitment to the Interstate versus the ABCD System as measured by the percentage of total Federal expenditure, by system, over time. This figure indicates that Interstate went from 0% to 50% in the mid-to-late 50's, remained essentially constant

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[1]All dollar values in this paper are in current dollars unless specifically expressed as constant (or deflated) dollars.

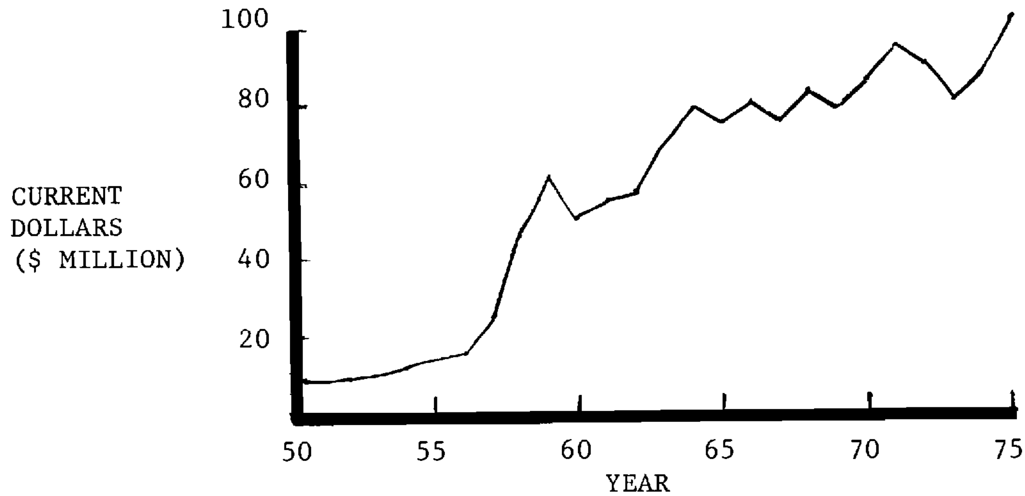

Figure 1. Average Current-Dollar Federal Highway Expenditures per State vs. Time

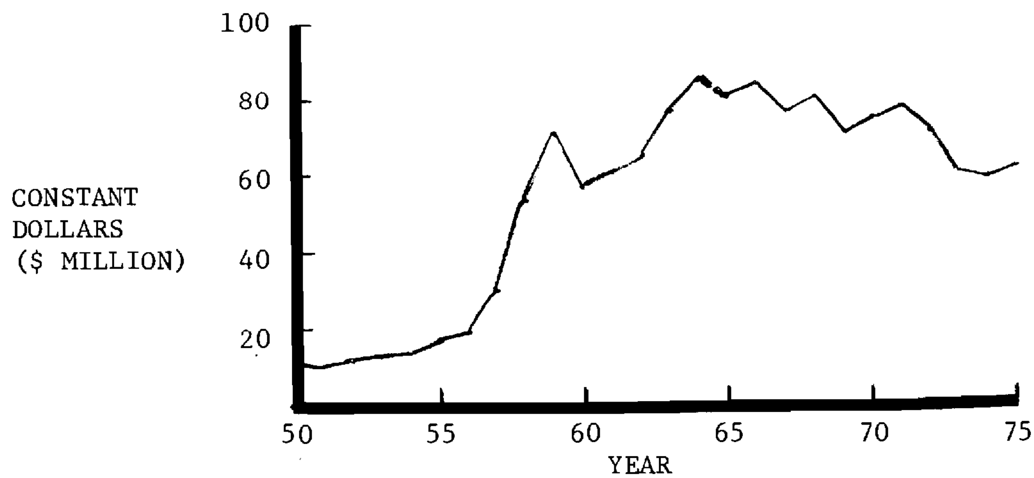

Figure 2. Average Constant-Dollar Federal Highway Expenditures per State vs. Time (1967 Base)

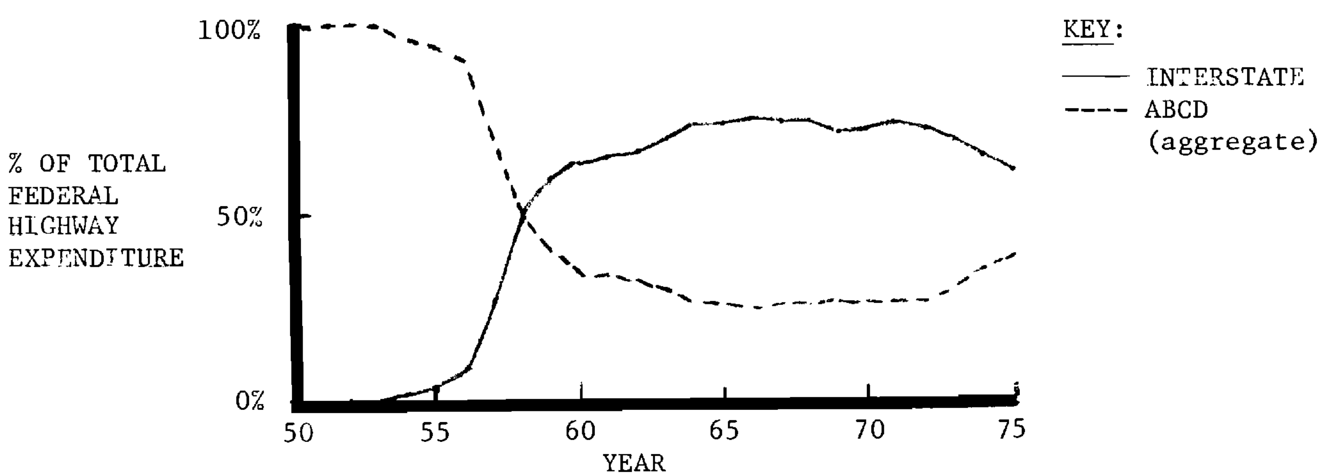

Figure 3. Relative Federal Commitment to the Interstate vs. the ABCD System

at about 70% through the 60's, and has dropped through the 70's down to about 60% again. The ABCD system is the complement of this.

How historically has the Federal government attempted to help the states through such efforts as changes in matching ratios? Figure 4 depicts the percentage Federal matching share, by system, over time. Here we see that the Federal government currently pays 90% of Interstate capital expenditures and pays 70% of ABC capital outlays.[1] The 1970 Federal Aid Highway Act changed the ABC ratio from 50% to 70%, effective fiscal year (FY) 1974 (calendar year '73).

In summary of the Federal perspective, therefore, we see that the Federal government has increased Federal aid in terms of current dollars since 1950; however, when corrected for inflation, these expenditures have actually been decreasing since about 1965. Moreover, the Federal government showed an early commitment to the Interstate system but is now approaching a point of equal emphasis with the ABCD program, if an extrapolation of Figure 3 can be believed. Federal decision-makers, through policy actions such as the FY1974 change in ABC systems matching requirements, have changed the states' highway picture. The question is how did the states respond. We now shift to a state perspective.

B. Scenario: the State Perspective

We of course realize that the scenario from the state perspective will vary from state to state, but our purpose here is to provide a "ballpark feeling" of the big picture. Therefore, we proceed using the average

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[1] The Public Land States (PLS) have traditionally gotten higher percentages than those shown in both the Interstate and ABC systems (see Table 1), but we keep things simple for now. The Surface Transportation Act of 1978 changes the ABC share to 75%.

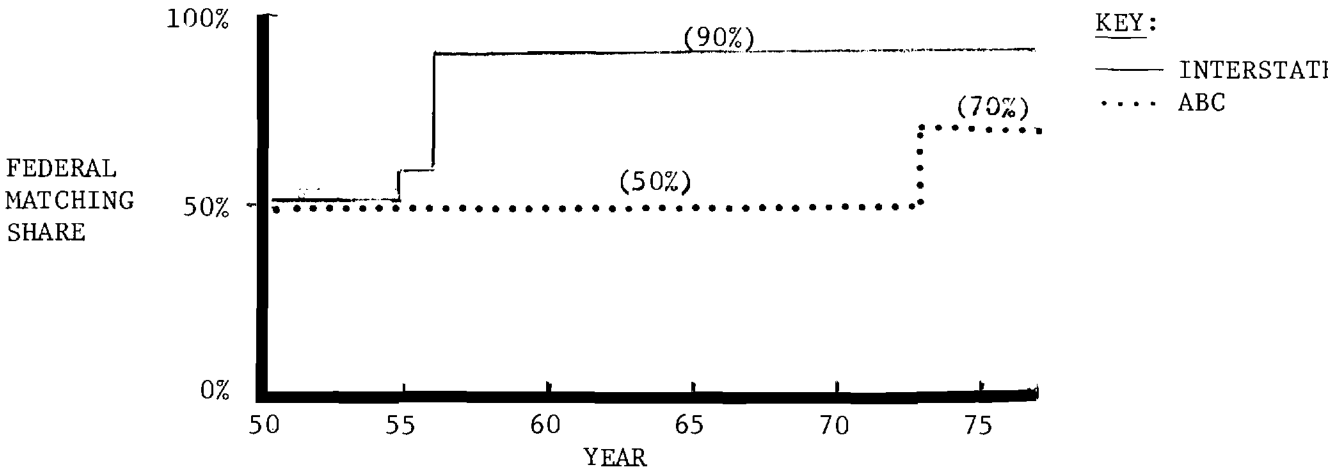

Figure 4. % Federal Matching Share, by System, over Time

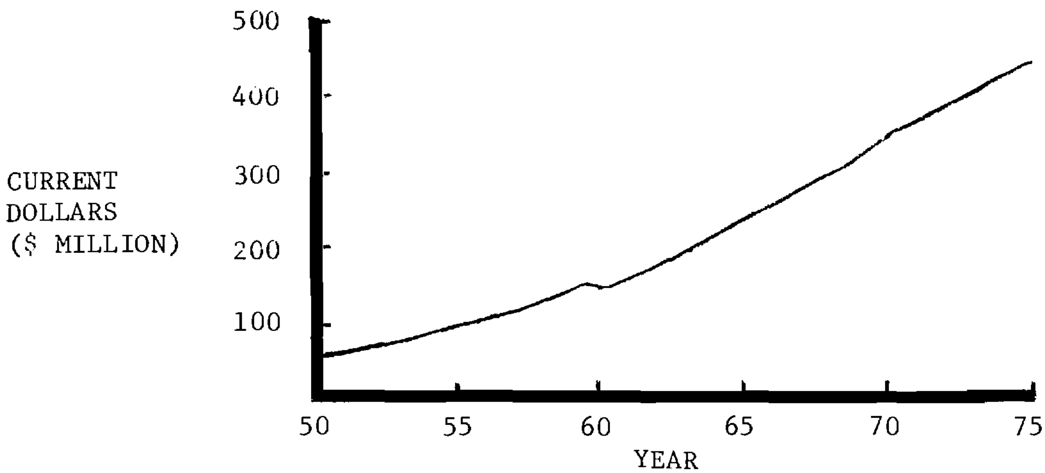

Figure 5. Average State's Current-Dollar Highway Expenditures vs. Time

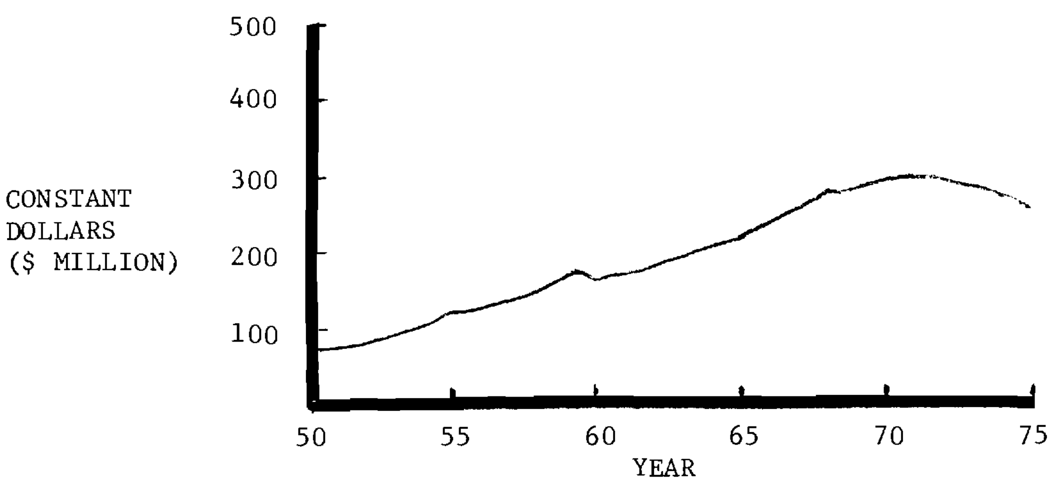

Figure 6. Average State's Constant-Dollar Highway Expenditures vs. Time (1967 Base)

of the 48 continental states. (Later we attempt to capture some of this variation.)

Figure 5 shows the average state's total highway disbursements in current dollars versus time. These disbursements include those on maintenance and non-Federal-aid roads, and, of course, include expenditures made possible by the Federal aid discussed above. As may be seen from this figure, this value has increased almost linearly to its 1975 value between 400 and 500 million dollars. The state level in the early 50's was about seven times the corresponding Federal expenditure (Figure 1); in the early 60's it was down to 3 to 1; in the early 70's the figure was 4 to 4½ times. Figure 6 gives the same data as in Figure 5 corrected for inflation; here we see a linear increase up until around 1970, when a decreasing trend began.

The ratio of the state highway expenditures (of Figure 5) to state general expenditures is shown in Figure 10. This figure shows a dramatic decline in the proportion of the state budget for highways from about 30% in the early 60's to 20% in the early 70's. (The figure is less than 15% for the public land and industrial states.) This is in spite of a rising Federal contribution. This decline contrasts sharply with the states' description of their highway needs. According to calculations based on the <u>1974 National Transportation Report</u> (<u>74 NTR</u>)[1], state highway needs in 1990 will be (very) roughly at least twice present expenditures <u>in real dollars</u>. The Federal government, recognizing this problem, has changed its view of needs to one based on the concept of performance-related

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[1]U.S. Department of Transportation (DOT), <u>1974 National Transportation Report</u>, Washington, D.C., July 1975.

investment.[1] This view recognizes the unrealistic nature of obtaining maximum system performance, and instead prioritizes work to meet a level of performance specified by available funds. The National Highway Inventory and Performance Study (NHIPS) provided data of two types in support of the new needs approach: a survey of mileage and travel, and an inventory of physical and operating conditions.

We now look briefly at state highway expenditures after Federal contributions have been subtracted out. (We call these values the "state-only" values.) Figure 7 shows the state-only capital outlay commitments to the Interstate and ABCD systems relative to each other (i.e., % Interstate + % ABCD = 100%). This figure indicates a current ABCD commitment of over 80%; this value has been slightly increasing since 1956; conversely the Interstate value has decreased slightly since 1956 to a value under 20%. Thus, roughly speaking, states currently expend four to five times as much of their state-only capital funds on the ABCD system as on the Interstate. Figure 8 adds in (state-only) expenditures on non-Federal-aid roads and thereby illustrates through the use of pie charts the relative import of spending on the non-Federal-aid highways. Expenditures on non-Federal-aid highways are seen to be a significant and growing part of the pie. It is interesting to note that ABCD expenditures have remained constant at about 2/3 from 1955-1975; the decreasing percentage of Interstate funds has been replaced by non-Federal outlays.[2]

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[1] U.S. Department of Transportation (DOT), The Status of the Nation's Highways: Conditions and Performance, Washington, D.C., September 1977.

[2] State highway systems have become substantially larger since the 1950's. If many local roads have been put on the state highway system, this may be the reason for the increase in non-Federal road expenditures.

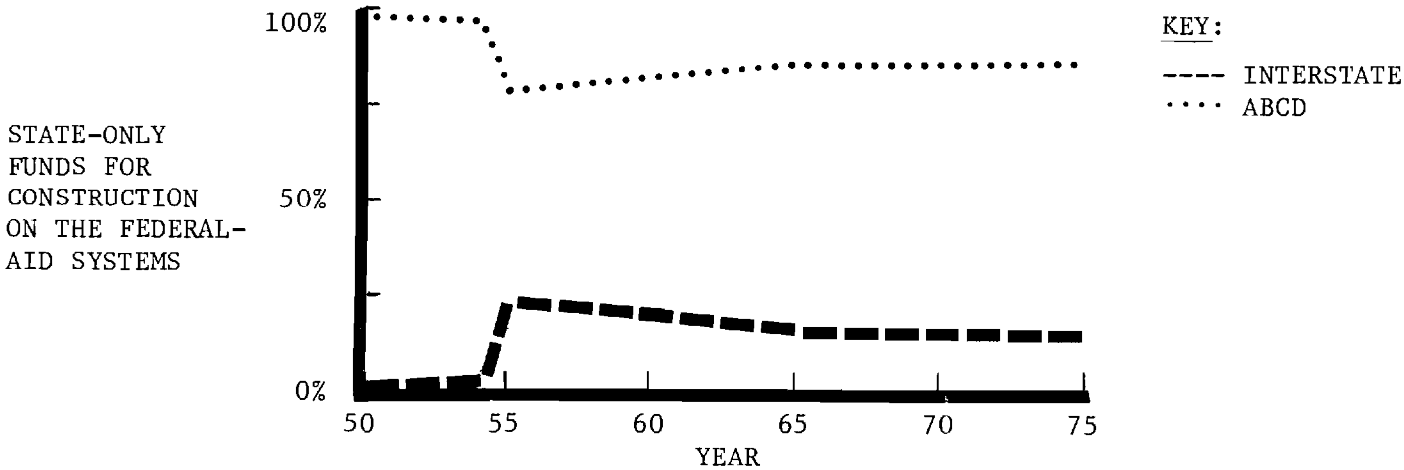

Figure 7. Relative State Commitment to Interstate vs. ABCD System (% of total state expenditure on Federal-aid highways, by system, over time)

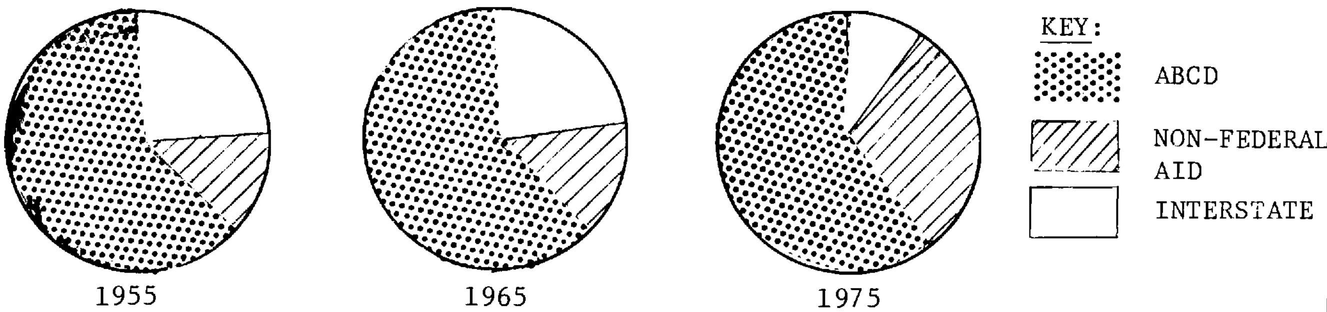

Figure 8. State-Only Expenditures by System

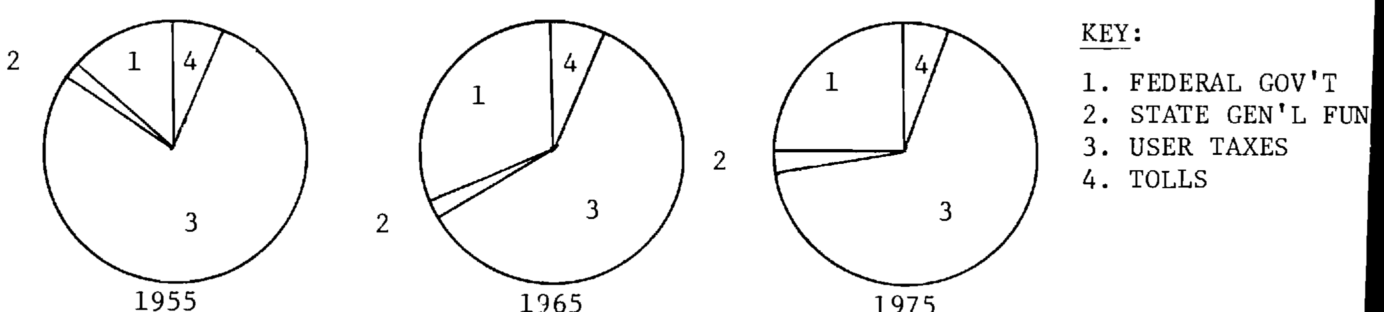

Figure 9. Sources of State Highway Revenues

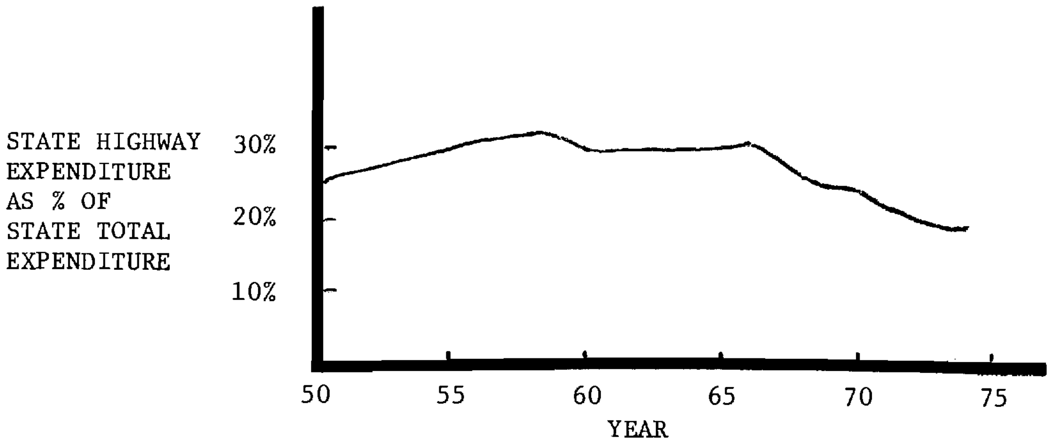

Figure 10. State Highway Expenditures as a Percentage of State General Expenditure

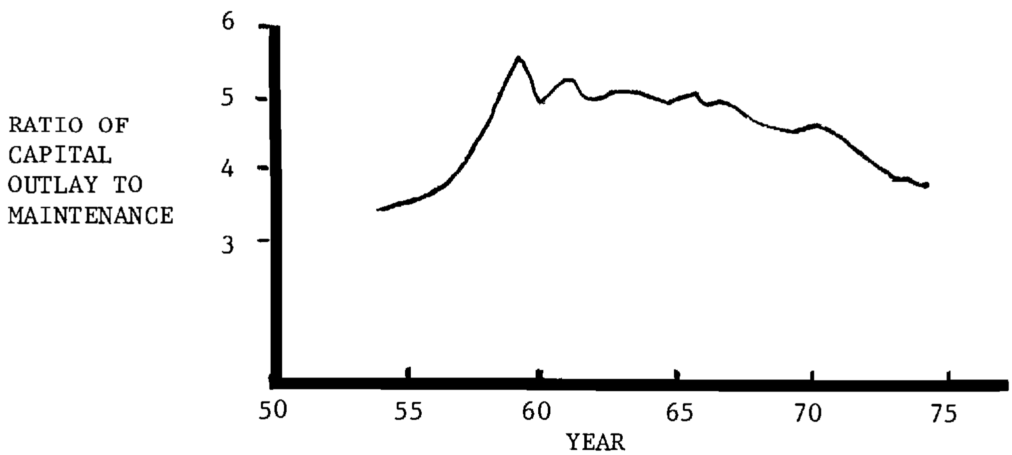

Figure 11. Highway Capital-Outlay-to-Maintenance Ratio, over Time

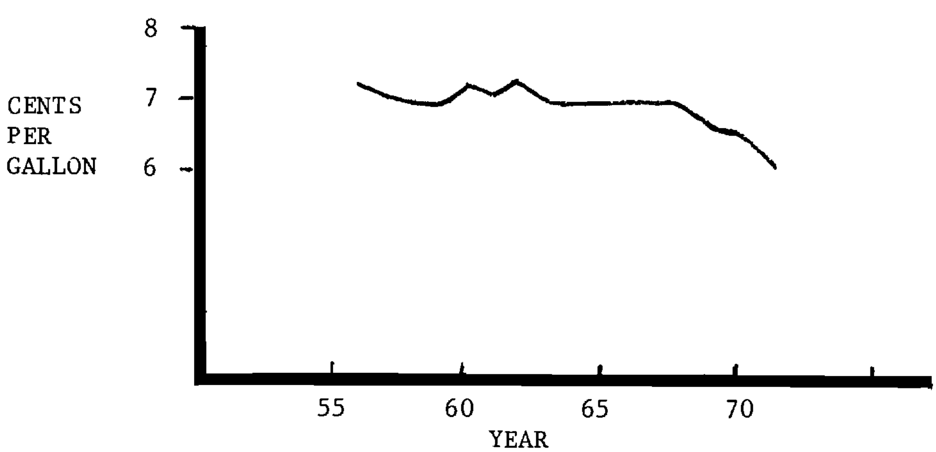

Figure 12. Average State-Only Constant-Dollar Highway Gasoline Tax, Over Time (Base = 1971)

[SOURCE: '74 NTR, page 465]

Are the states becoming heavily involved with maintenance or is construction still of primary import? The capital-outlay-to-maintenance ratio is used as one possible measure and is plotted in Figure 11. This ratio was around 4:1 in 1957, increased and then held at 5:1 over the period 1958 to 1968, and has been declining since then, reaching the value 3.7 to 1 in 1975. It should be further noted that the Northeastern states are currently very low (around 2:1), whereas the Southern states are high (at 4:1). This is not too surprising when one considers the heavy highway usage in the Northeastern corridor, the generally worse weather (maintenance-wise) there, the fact that these states' highway systems are largely in place, and the lower population growth there.

To round out this scenario and to lay some groundwork for later questions on fairness and equity, we ask how the states have raised their highway revenues. Figure 9 shows the percentage breakdown for the four revenue sources:

- Federal government
- state general fund
- user taxes
- tolls.

(Other sources are assumed negligible for now.) The breakdown indicates that highway user taxes are by far the predominant source, with Federal government funds (also based on user taxes) a distant second. It should be added that between 5 and 6% of these funds have been diverted to non-highway use for each of the pie-chart periods shown.

Summarizing the state perspective, therefore, we see that states obtain their highway revenues primarily from highway user taxes, with Federal government funds secondary. The states have increased their level of expenditures over time while decreasing the proportion of the state budget expended on highways. States currently lay out (roughly) four to five times the amount of state-only capital on the ABCD program as on the Interstate system; and for every five dollars spent on highways, more than one dollar goes to maintenance (with the trend toward even greater maintenance expenditures). The states project their 1990 needs to be significantly greater than present expenditures, even in constant dollars.

We pause to take cognizance (in light of our overall objective of understanding state response to Federal initiatives) that at a macro level the higher Federal matching ratio supplied by the Highway Act of 1970 (taking effect FY1974) appears to have had no significant effect on the average state's expenditure level. This observation is fairly significant as this Act increased the Federal-share matching ratio from 50% to 70% - a substantial change.

C. Scenario: the Taxpayer Perspective

Figure 12 shows the average highway gasoline tax in cents per gallon (corrected for inflation with 1971 as base) over the last twenty years. It is seen that this form of user tax, expressed in constant dollars, was fairly constant from 1955 to 1968, at which time it started decreasing rather dramatically.

Figure 13 shows the distribution by state of the same tax for the year 1973; in that figure the height of each bar represents the number of states at that rate. The dispersion of the states from their average is fairly wide, with Connecticut paying twice the rate (10¢) as some of the residents of Texas (5¢).

That the Federal government has long been interested in maintaining equity between states can be easily demonstrated. Since the early 1920's

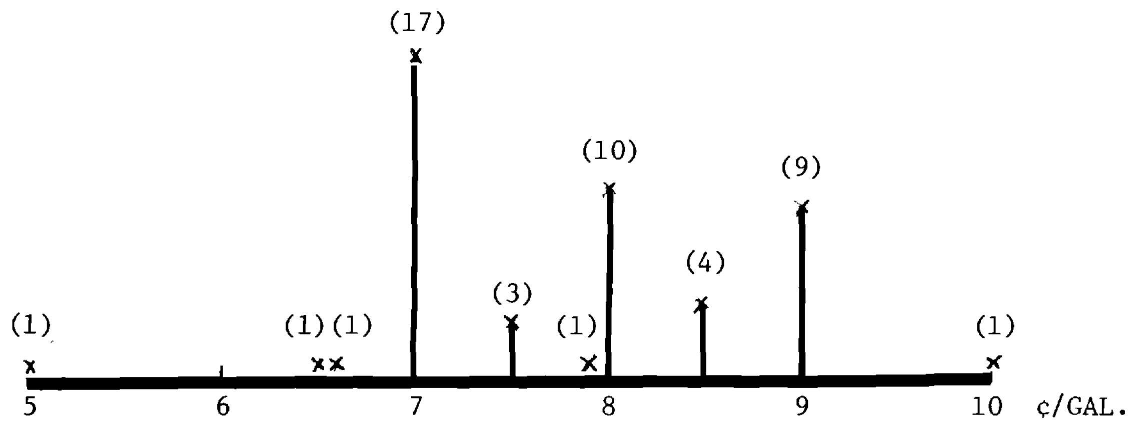

Figure 13. 1973 State Highway Gasoline Tax in Cents per Gallon
[Source: 74 NTR, p. 471]

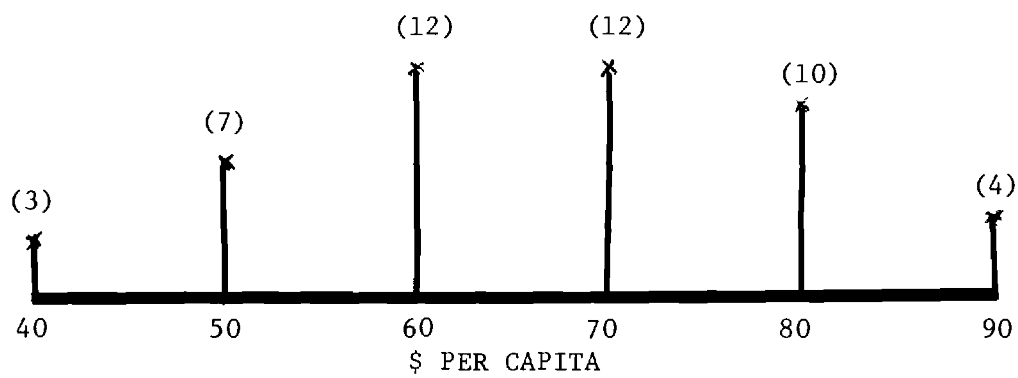

Figure 14. Per Capita Highway Tax Burden (1975)

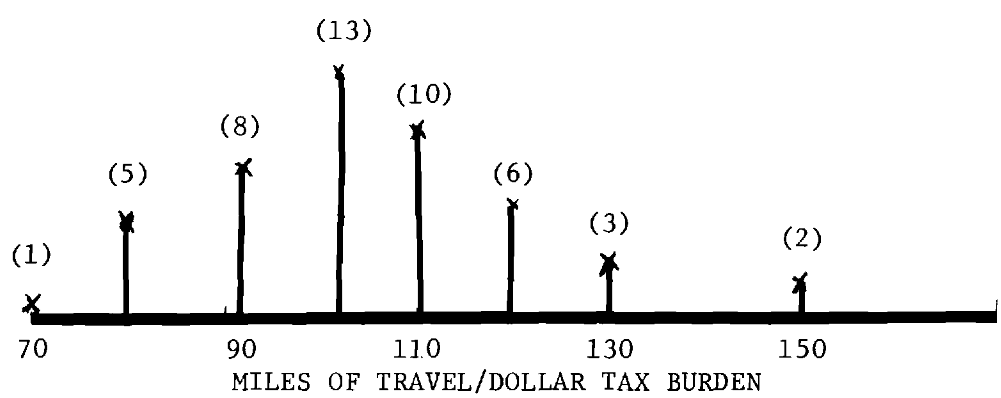

Figure 15. Modified "Benefit"-to-"Cost" Ratio (1975)

those states with large sectors of public land have received advantageous Federal-highway-aid provisions. (This is because it would be unfair for the citizens of a state to have to pay for large stretches of highway across public lands that happen to fall in their state.) Hence, we present three different ways of looking at equity.

Figure 14 gives the distribution of per capita "tax burden" by state for 1975; "tax burden" is placed in quotes because we use our own definition: the sum of state highway user receipts and highway appropriations from general funds. The figure indicates that the tax burden varies from $40 per capita in New York, Massachusetts, and Utah to $90 per capita in Wyoming, Oklahoma, Vermont, and Washington. The distribution of states looks approximately normal with a mean of $66/capita. Another variant of equity measure might be a modified "benefit-to-cost" ratio.[1] In Figure 15 we show this ratio, where we have defined "benefit" to be vehicle miles of travel and "cost" to equal tax burden. Here we see that Utah and Georgia get 150 miles of travel per dollar of tax burden, whereas West Virginia gets only around 70. And finally, we consider another kind of equity: time equity. States with large bond indebtedness imply a burden (and therefore a possible inequity) on future generations. This is an important consideration since (as we saw in Figure 12) highway user taxes are not holding their own. Thus we depict in Figure 16 inequities on future generations based on 1975 bond indebtedness. This figure looks like an exponential distribution, with a wide dispersion of inequity. It should be pointed out, however, that in some states the burden will be usage dependent; that is,

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[1]This ratio is in no way to be construed to be a typical benefit-cost ratio, whose value is to be compared with unity to determine project acceptance.

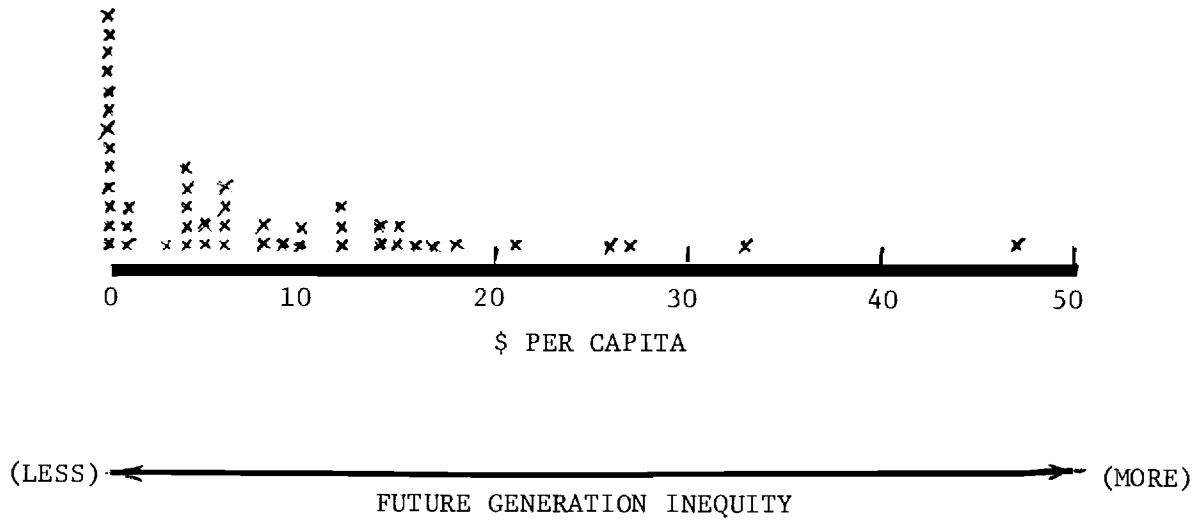

Figure 16. Per Capita Bond Indebtedness (1975)

the future burden will be paid as tolls by the future users.

Thus we see from the taxpayer's perspective that, in deflated dollars, highway user taxes have actually been declining and that the average highway gasoline tax varies quite widely across the country. Equity-wise, according to three different measures, wide dispersions are also found in the different states. There is no unanimity in "suffering" across the different measures.

III. Key Variables

If one proceeds purely on the basis of the results of the above overview, one would be tempted to model total state highway expenditures as a linearly increasing function of time, with 2/3 of the monies going to ABCD and a decreasing percentage to the Interstate system; this "average" state model would be postulated regardless of Federal initiatives. For now, we ignore this point of view and postulate that states will in fact respond to Federal initiatives. We build an intuitive model to predict these responses, attempting to capture some of the variability between states which we have so far ignored. We begin by hypothesizing key factors in the state decision-making process.

We propose that there are four major considerations in a state's decision regarding its expenditure level on a given system for the upcoming year:

- Last year's expenditure level
- Fiscal constraints
- The state's perception of its needs for that system, and
- Federal initiatives (matching ratio and level of aid).

We now define a proxy variable which we call the "program effect." The program effect is a variable which captures such factors as Federal matching ratio, Federal level of aid, and the state's last-year expenditure level. (We elaborate in a moment.) We thus are left with three variables: "program effect," fiscal capability, and needs. We now look at each of these in turn.

A. "Program Effect"

We first note that states historically do not forego Federal highway monies. Therefore, we define the "program effect" as the total (state + Federal) program amount which must be expended if the state is to capture all Federal funds, expressed as a fraction of what the total program amount was last year. If this year's program must be $20 million to get all Federal money, and last year's was $10 million, then the program effect is 2.0. It should be noted that the "program effect" may be less than, equal to, or greater than unity. Moreover, last year's expenditure level, as well as this year's Federal matching ratio and promised level of funds, are all subsumed in this new variable. Table 1 lists the "program effect" for the states due to the Federal funding policy changes of FY74; observe that the "program effect" is <u>less than unity</u> for most of the states. (Therefore, spending may be reduced for most states and all Federal funds will still be captured.) For example, consider Arizona. It may be shown that

$$\text{Program Effect} = \left(\frac{\text{Federal aid after}}{\text{Matching ratio after}}\right) * \left(\frac{1}{\text{program level before}}\right)$$

$$\text{or} \qquad \text{P.E.(AZ)} = \left(\frac{36{,}430.3\text{K}}{.86}\right)\left(\frac{1}{48{,}659\text{K}}\right) \approx 0.871$$

B. Fiscal Capability

When including fiscal capability in our model, we really want to assess the relative abilities of states to respond to financial stringencies (such as that caused by the early-70's oil crisis or a sudden cutback

Table 1. ABCD "Program Effect" of the 1973 Federal Aid Highway Act Changes

State	Pre-Change Matching Ratio	Post-Change Matching Ratio	Post-Change "Program Effect"
Public Land States			
NV	.90	.94	1.06
AZ	.77	.86	.87
UT	.76	.86	1.02
WY	.66	.80	.73
NM	.64	.79	.75
OR	.64	.78	.87
ID	.63	.78	.70
CA	.59	.76	.95
CO	.57	.74	.73
MT	.57	.74	1.02
SD	.55	.73	.76
WA	.53	.72	.35
MEDIAN	.635	.78	.815
Non-Public Land States			
AL	.50	.70	.45
AR	.50	.70	.64
CT	.50	.70	.50
DE	.50	.70	.49
FL	.50	.70	.42
GA	.50	.70	.58
IL	.50	.70	1.12
IN	.50	.70	.49
IA	.50	.70	.37
KS	.50	.70	.86
KY	.50	.70	.48
LA	.50	.70	.28
ME	.50	.70	.98
MD	.50	.70	.27
MA	.50	.70	.75
MI	.50	.70	.86
MN	.50	.70	.66
MS	.50	.70	.35
MO	.50	.70	.48
NE	.50	.70	.90
NH	.50	.70	.28
NJ	.50	.70	.45
NY	.50	.70	.44
NC	.50	.70	.81
ND	.50	.70	.68
OH	.50	.70	.60
OK	.50	.70	.55
PA	.50	.70	.33
RI	.50	.70	1.04
SC	.50	.70	.38
TN	.50	.70	.51
TX	.50	.70	?
VT	.50	.70	.48
VA	.50	.70	.12
WV	.50	.70	.15
WI	.50	.70	4.11
MEDIAN	.50	.70	.49

Note: In computing the "program effect," expenditure data were used and a one-and-a-half year time lag was assumed between the appropriation and its expenditure (i.e., to evaluate the "post-change" program effect, federal aid was assumed to be the 1975 calendar year (CY) expenditure, and the last-year program level was assumed to be the CY 1974 federal + state expenditure).

in Federal funds). The existing level of fiscal capability is reflected in the state's previous year's expenditures. We want to know the state's ability to "be elastic" in deviations from that existing level. The more fiscally capable a state is, the more elastic it will be in stretching funds to meet financial strictures. Note that an extra infusion of funds to a state represents a different animal than a cutback in funds; therefore, the response by a state to an influx of extra Federal funds may not be predictable from that state's response to a cutback in Federal funds.

We develop two different measures of fiscal capability. The first utilizes the fact that states obtain their revenues primarily from state-highway user taxes and secondarily from Federal funds (recall Figure 9). We argue that in a stringency if a state does not raise its user tax, what is important is the state's dependence on Federal funds. We therefore divide the states into two categories, "dependers" and "self-reliers." We do this by looking at percent dependence on Federal aid [dependence = Federal aid divided by total highway expenditures in the state: non-Federal, Federal, and state (including maintenance as well as construction)]. Table 2 shows the breakdown by states into the two categories according to the average of 1973, 74, and 75 data.

The second measure appeals directly to the elasticity definition. In 1972 a needs study was conducted (<u>72 NTR</u>, pages 116; 172). In this study each state was asked to develop a Capital Improvement Program under the most likely future Federal funding structure (called "Funding Alternative II" - FA II); each state was also asked to provide a similar program under the stipulation that future Federal funding would be one-half that of the most likely case ("Funding Alternative I" - FA I). We chose as our second measure of fiscal capability the % change between alternatives [(FA II - FA I)

Table 2. Fiscal Capability Measure 1: State Dependence on Federal Funds

State	Dependence (%)
"Dependers"	
Rhode Island	51.2
Montana	45.9
Utah	45.3
Nevada	44.1
Wyoming	38.5
New Mexico	37.0
North Dakota	35.5
Arizona	34.8
Oregon	32.5
Colorado	32.2
Idaho	32.1
West Virginia	31.2
Vermont	30.7
"Self-Reliers"	
Connecticut	13.8
New Jersey	15.9
Kentucky	16.2
Pennsylvania	16.4
Mississippi	16.4
New York	17.0
North Carolina	17.3
Delaware	17.5
Maryland	17.7
Oklahoma	18.3
Massachusetts	18.3
Florida	18.6
Indiana	19.1
Ohio	20.0
Wisconsin	20.3
Arkansas	20.7
Iowa	21.0
South Carolina	21.6
California	22.0
Illinois	22.1
Tennessee	22.3
Maine	22.3
Virginia	22.7
New Hampshire	23.1
Michigan	23.5
Louisiana	23.7

Note: % dependence is computed by dividing Federal aid by total state highway expenditures on all roads, including construction and maintenance. Those states below dashed lines in each category should be considered "marginal."

Note: Only 39 states are listed. The other states are between 25 and 30 percent dependence and hence are not placed in either fiscal capability category.

* 100% ÷ FA II]. Table 3 shows a ranking of states by this measure. Here we call states "cutters" (they'll cut their own state-only spending if the Federal government cuts its funds), "maintainers" (they'll hold their own on state-only money even if Federal funds are cut), and "supplanters" (they'll supplant the cut Federal funds with extra state funds).

An improved method of classifying states according to fiscal capability is due to Cooper and has come to our attention since our analysis was completed. Cooper uses Federal aid as a percent of capital, bonds as a percent of capital, and debt service as percent of revenue to partition the states into six groups.[1]

C. Needs

Existing needs-related data from the 72 NTR and 74 NTR were used to develop our needs estimates. Discussions with highway-knowledgeable persons disclosed two main criticisms of the data, however. First, the 72 NTR data are too "pie-in-the-sky," for the data were developed "without consideration of the availability of funds" (72 NTR, p. 116). And secondly, although the 74 NTR data do include considerations of funding availabilities, some states seemed to accept these financial constraints while others did not. Recognizing the seriousness of these shortcomings, we proceeded nonetheless as this was the best collection of data in hand at the time. It was hoped that some meaningful patterns would emerge.

We defined three distinct needs measures. The first two were derived from 74 NTR data, and the third from 72 NTR. The first measure is a per capita measure and is the (74 NTR projected value of) 1990 Plan capital

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[1] Cooper, Thomas W., The State Highway Finance Outlook, U.S. Department of Transportation, Washington, D.C., December 1978. See pages 38-39 in particular.

Table 3. Fiscal Capability Measure 2: % Change Due to Cutback in Funding

$$(\% \Delta = \frac{FA\ II - FA\ I}{FA\ II} * 100\%)$$

Rank	State	% Δ
"Cutters"		
1	MA	50.0%
2	MO	50.0
3	NY	49.7
4	MT	48.2
5	NM	47.1
6	AL	46.7
7	OK	46.3
8	VT	46.3
9	DE	45.8
10	CO	45.7
11	ID	44.3
12	KY	44.1
13	WY	40.6
14	TN	39.8
15	GA	36.5
16	MN	36.4
17	KS	36.3
18	UT	35.9
19	OR	35.0
20	WV	34.8
21	MI	33.8
22	AZ	33.3
23	OH	32.9
24	NC	32.3
"Maintainers"		
25	NH	29.4
26	AR	27.7
27	SC	27.7
28	TX	27.7
29	ME	26.6
30	CT	26.5
31	IA	26.1
32	PA	25.8
33	NE	24.7
34	FL	23.9
35	RI	23.5
36	WA	23.2

Rank	State	% Δ
"Maintainers," cont'd		
37	IL	22.7%
38	MS	22.3
39	WI	21.2
40	CA	20.0
41	VA	19.4
"Supplanters"		
42	NV	15.0
43	MD	12.4
44	ND	12.0
45	LA	7.5
46	SD	6.3
47	NJ	2.5
48	IN	-1.5%(?)

Source: Calculations based on 72 NTR, page 174.

costs per capita per year. The second measure is a comparison of the first measure with a linear extrapolation of each state's current spending; some states thus project a revenue shortfall (and hence are "needers"), whereas others project a surplus (and hence are not so needy - they are "havers"). And finally, the third measure is taken from 72 NTR, representing each state's total highway needs without regard to funding possibilities. All of the states were ranked according to each of the three measures; this compilation is shown in Table 4. (Supporting data for the three needs measures are shown in Tables 5 through 7).

One does not need to peruse the data for long to realize that the three needs measures are not in perfect harmony. The case of California is illustrative: need measure 1 states that California is the least needy of the 48 states; need measure 3 insists it is the most needy. The correlations among these three measures are[1]

	Need 1	Need 2	Need 3
Need 1	1.00	.81	-.01
Need 2		1.00	.23

This supports the observation that "needs" vary tremendously depending on the estimation procedure, whether on a per capita basis or not, and whether or not financial capabilities are considered.

As mentioned above, the NHIPS study (available after our initial study was concluded) provides a way around these difficulties. Because (almost) all states have been inventoried according to highway physical conditions, travel characteristics, and safety, comfort, and convenience factors, an assessment of need priority relative to a total national fiscal posture can

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[1]These are rank order correlations - Spearman's rho (ρ).

State	(1990 Plan Annual Capital Costs per Capita) Measure 1	(1990 Projection Revenue Surplus or Shortfall) Measure 2	(Pure "pie-in the-sky" needs estimate, per 72 NTR) Measure 3
AL	36	30	28
AZ	7	8	39
AR	1	1	24
CA	48	44	1
CO	34	20	34
CT	46	43	29
DE	33	48	47
FL	11	17	15
GA	22	15	21
ID	30	27	45
IL	13	14	8
IN	29	42	18
IA	3	9	19
KS	17	22	31
KY	40	34	9
LA	14	10	27
ME	38	37	37
MD	26	25	25
MASS	44	26	13
MICH	43	29	6
MINN	32	38	26
M'PI	21	18	23
MO	4	3	16
MONT	10	11	30
NEB	25	16	35
NEV	20	31	48
NH	42	41	38
NJ	18	6	7
NM	27	23	33
NY	16	12	4
NC	5	4	14
ND	12	24	40
OH	45	36	5
OK	47	47	32
OR	41	35	10
PA	37	33	3
RI	35	39	42
SC	23	13	36
SD	19	28	46
TN	9	2	22
TX	6	5	2
UT	39	40	43
VT	31	46	41
VA	24	21	11
WA	28	45	20
WV	15	32	12
WI	8	7	17
WY	2	19	44

Note: #1 represents greatest need; #48 indicates least need.

Table 5. Need Measure 1

State		Need	State		Need
1.	AL	70	25.	NEB	91
2.	AZ	167	26.	NEV	104
3.	AR	263	27.	NH	61
4.	CA	40	28.	NJ	112
5.	CO	78	29.	NM	84
6.	CT	49	30.	NY	116
7.	DE	79	31.	NC	171
8.	FL	143	32.	ND	137
9.	GA	100	33.	OH	49
10.	ID	82	34.	OK	45
11.	IL	129	35.	OR	63
12.	IN	83	36.	PA	69
13.	IA	205	37.	RI	76
14.	KS	116	38.	SC	94
15.	KY	64	39.	SD	107
16.	LA	127	40.	TN	165
17.	ME	68	41.	TX	169
18.	MD	86	42.	UT	64
19.	MASS	57	43.	VT	81
20.	MICH	59	44.	VA	92
21.	MINN	80	45.	WA	83
22.	M'PI	104	26.	WV	118
23.	MO	194	47.	WI	165
24.	MONT	151	48.	WY	223

Note: This need measure = 1990 Plan Hwy. Capital Costs per capita per year.

Source: U.S. DOT, 1974 National Transportation Report, p. 95ff (Table III-R-13).

Table 6. Need Measure 2

Surplus of revenues (Havers)

State	%	
Delaware	33	"Havers"
Oklahoma	28	
Vermont	25	
Washington	25	
California	21	
Connecticut	20	
Idaho	19	
New Hampshire	17	
Utah	10	"Marginal Havers"
Rhode Island	7	
Minnesota	6	
Maine	3	
Ohio	2	
Oregon	0	

Shortfall (Needers)

State	%	
Kentucky	3	"Marginal Needers"
Pennsylvania	4	
West Virginia	6	
Nevada	7	
Alabama	7	
Michigan	7	
South Dakota	8	
Indiana	10	
Massachusetts	13	
Maryland	15	
North Dakota	15	
New Mexico	15	
Kansas	16	
Virginia	17	
Colorado	18	
Wyoming	20	
Mississippi	27	
Florida	46	"Needers"
Nebraska	51	
Georgia	51	
Illinois	53	
South Carolina	72	
New York	72	
Montana	75	
Louisiana	78	
Iowa	79	
Arizona	90	
Wisconsin	95	
New Jersey	126	
Texas	128	
North Carolina	168	
Missouri	176	
Tennessee	203	
Arkansas	267	

Note: This measure derives from an extrapolation of current spending compared with states' 1990 projections. (From, U.S. DOT, 1974 National Transportation Report, p. 478.)

Table 7. Need Measure 3

(Need Measure 3 = Total State Need in Millions of Dollars)

Rank	State	Total Need	Rank	State	Total Need
1	CA	$39017.7	25	MD	$ 8331.5
2	TX	35850.3	26	MN	8208.4
3	PA	35425.0	27	CA	7974.0
4	NY	31292.8	28	AL	7741.5
5	OH	26868.5	29	CT	7048.8
6	MI	25391.9	30	MT	6825.1
7	NJ	24062.5	31	KS	6738.2
8	IL	22341.9	32	OK	6382.8
9	KY	19421.4	33	NM	5569.7
10	OR	18193.0	34	CO	4971.3
11	VA	16433.1	35	NE	4888.0
12	WV	15526.2	36	SC	4792.3
13	MA	14157.9	37	ME	4416.5
14	NC	14071.6	38	NH	4203.4
15	FL	13541.0	39	AZ	3657.9
16	MO	12123.2	40	ND	3612.3
17	WI	11775.7	41	VT	3590.5
18	IN	11207.7	42	RI	3387.9
19	IA	10489.1	43	UT	2922.1
20	WA	9789.5	44	WY	2418.8
21	GA	9715.4	45	ID	2413.7
22	TN	9473.4	46	SD	2372.7
23	MS	8711.7	47	DE	1266.9
24	AR	8459.2	48	NV	1255.8

Source: 72 NTR, p. 172.

now be made.

IV. Exploration: Impacts of the FY 1974 Matching Ratio Change

Our exploration centers around three aspects of the 1970 Federal Aid Highway Act, which changed the ABC Federal matching ratio from 50% to 70%, effective FY 1974. First, the states' historic ABCD matching tendencies are related to fiscal capability; these tendencies are then to be compared with the state's priority preference between the ABCD and Interstate systems. Second, the '70 Highway Act effects are examined to see if the policy change shifted state priorities toward an increased ABCD priority. And lastly, state expenditure levels are "predicted" across the matching ratio change with only the pre-change expenditure data being used in conjunction with the needs and fiscal capability measures. We now examine each of these aspects.

Aspect 1: Matching Tendencies and ABCD Priority Preference

We first notice that this policy change results in "program effects" of less than 1.0 for most states (recall Table 1). Hence, to capture all Federal money, states need not spend as much of their own money as before the policy manipulation. Now in attempting to select between our two measures of fiscal capability, we note that this situation does not entail fiscal constraint. Thus we propose measure 1 (dependence) as more appropriate. Recall that with this measure, states are divided into "dependers" and "self-reliers" (Table 2).

"Dependers" are essentially "matcher" states, whereas self-reliers are "builders" (5 of the first 9 states in Table 8 are in the top 13 "self-reliers"); i.e., "depender" states historically just meet their matching requirements, whereas self-reliant states exceed their requirements and

Table 8. State Classification as a Function of Overmatching Ratio

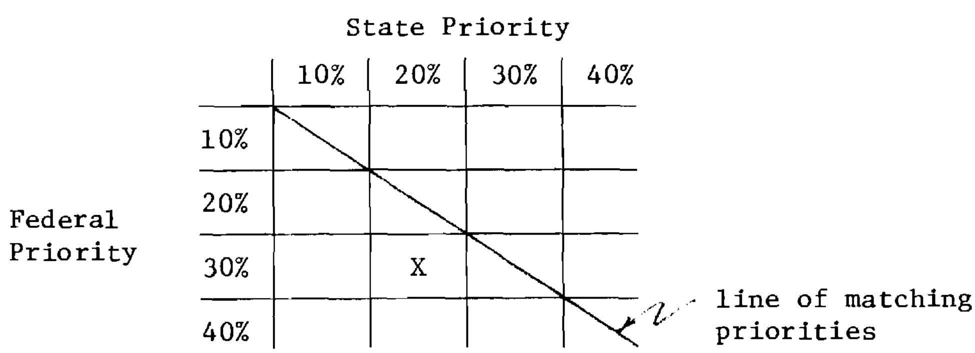
"Over-matching" Rank	Overmatching Ratio (in decreasing order)	State	State Classification: "Needer, Self-Reliers"	Dependers	"Haver, Self-Reliers"	Unclear
1.	0.69	MD				X
2.	0.65	CT			X	
3.	0.64	CA			X	
4.	0.58	FL	X			
5.	0.57	WV		X		
6.	0.55	OH				X
7.	0.53	PA				X
8.	0.53	NY	X			
9.	0.52	LA	X			
10.	0.52	VA				X
11.	0.48	WA				X
12.	0.47	IA	X			
13.	0.45	MASS				X
14.	0.43	WI	X			
15.	0.42	TN	X			
16.	0.40	KY				X
17.	0.39	TX				X
18.	0.39	MO				X
19.	0.39	MICH				X
20.	0.38	AZ		X		
21.	0.36	OR		X		
22.	0.36	DE			X	
23.	0.36	MN				X
24.	0.32	NH				X
25.	0.31	M'PI				X
26.	0.29	VT		X		
27.	0.29	AL				X
28.	0.28	SC	X			
29.	0.27	SD				X
30.	0.26	NC	X			
31.	0.26	OK			X	
32.	0.25	NJ	X			
33.	0.24	KS				X
34.	0.24	AR	X			
35.	0.20	ME				X
36.	0.20	RI		X		
37.	0.20	GA				X
38.	0.19	UT		X		
39.	0.19	NEV		X		
40.	0.19	CO		X		
41.	0.16	WY		X		
42.	0.14	IL	X			
43.	0.13	NM		X		
44.	0.12	IN				X
45.	0.11	NEB				X
46.	0.09	ID		X		
47.	0.05	MT		X		
48.	0.03	ND		X		

Note: Overmatching Ratio is from Sherman, L. R., The Impacts of the Federal Aid Highway Program on State and Local Highway Expenditures, U.S. DOT, Washington, D.C., 1975, p. 199. State classification is from Tables 2 and 6 (although Table 6 is not needed to draw the conclusions in the text).

hence overmatch historically (thus the name "builders"). Table 8 shows the state classification and its historic overmatching ratio as computed by Sherman.[1] We will come back to this in a moment.

We turn now to questions of priorities. If one assumes that Congressional priorities are implied by the percentage of total funds given to each program, and that matching ratios affect those priorities, one can ask the question, how do Congressional priorities match up with state priorities? (Note that we are not suggesting that both priorities should be numerically equal; in fact, often Congressional priorities are increased to aid "weaker" states with little or no expected state increase. We are just attempting to document and understand how both sets of priorities vary.)

To answer this, consider the following grid:



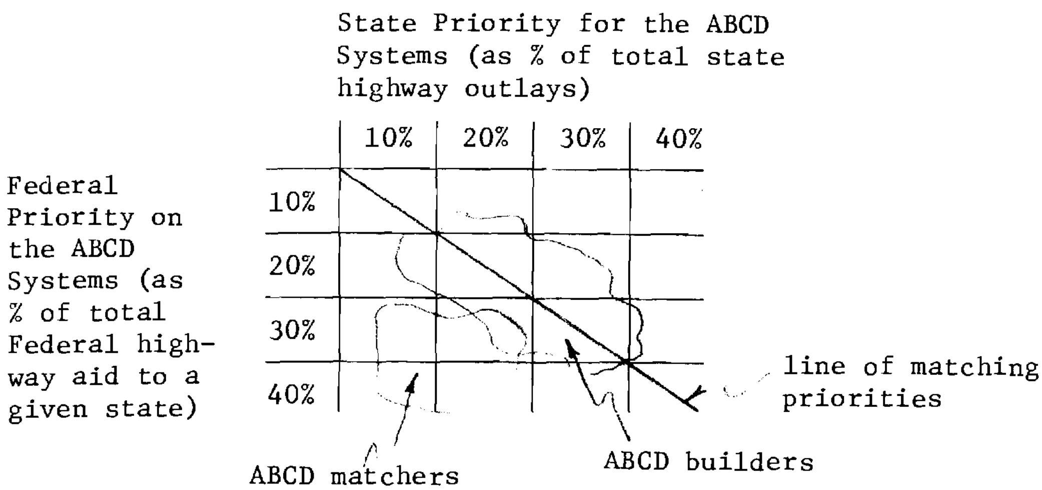
In the grid above, Federal priority is measured by % ABCD of total Federal highway expenditure, and state priority is measured by % ABCD of total program highway <u>expenditure</u>. At any point in time a state has a given state and Federal priority (for example, the "X" in the grid above represents a state with 30% of its Federal highway aid for the ABCD system, but 20%

---

[1] Sherman, L. R., <u>The Impacts of the Federal Aid Highway Program on State and Local Highway Expenditures</u>, U.S. DOT, Washington, D.C., 1975, p. 199.

of its total state outlay devoted to the ABCD system. Each state falling near the line of matching priorities, then, could be considered to have state ABCD system priorities about the same as the Federal government's. (This is not necessarily desirable; it is merely a reference point.) We observe that due to Federal apportionment schemes, etc., different states have different Federal priorities - itself an interesting issue.

We now postulate that ABCD matchers place relatively higher priorities on other highways (such as Interstate), and thus these states lie "to the left of" builders as shown in the grid below:



An actual plot showing each state's position as of 1973 is given in Figure 17. Here each "M" represents a "matcher" state and each "B" a "builder" state. The postulate is shown to be substantially correct.

Aspect 2: The 1970 Highway Act as a Priority Increaser

We now examine whether the policy changes implemented by the 1970 Highway Act shifted matcher priorities toward an increased ABCD priority.[1]

[1]The presumption is that these states would be more responsive to changes in Federal funding policies. ABCD "builder" states are those who have traditionally invested more in the system than necessary to obtain their Federal aid apportionment; hence, they are presumably less responsive to Federal policy changes.

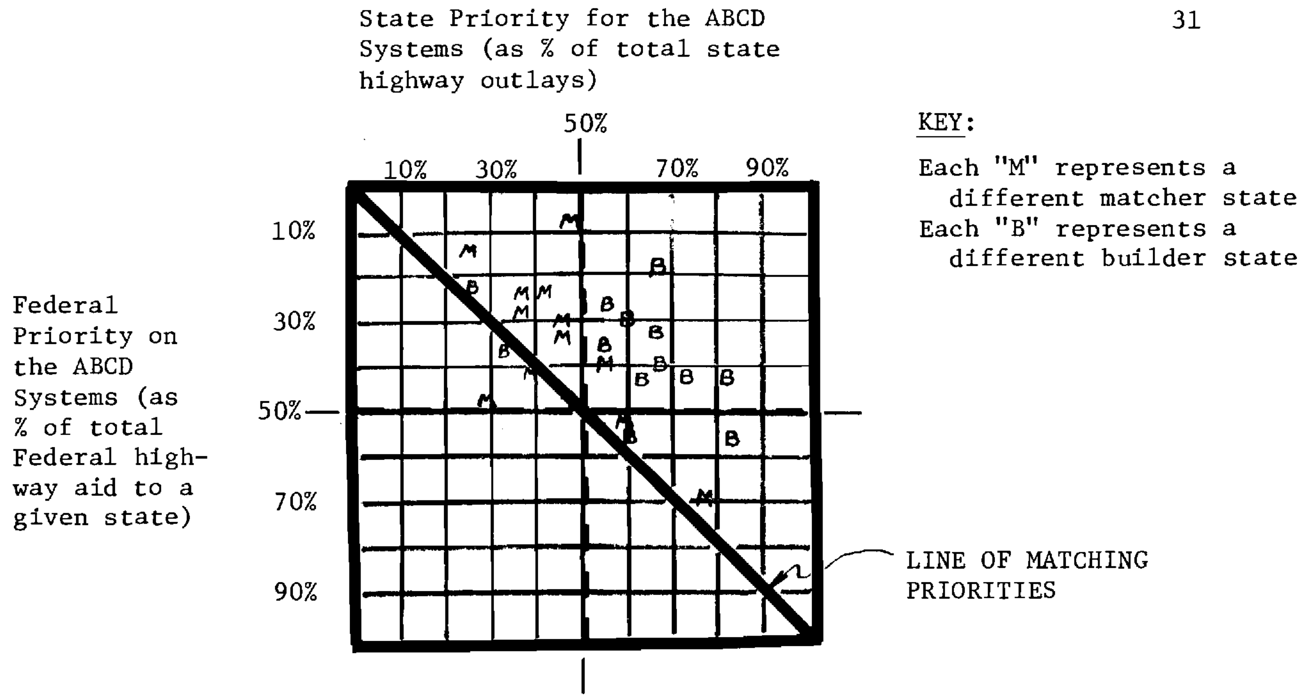


Figure 17. Federal vs. State Emphases on the ABCD Systems (1973)

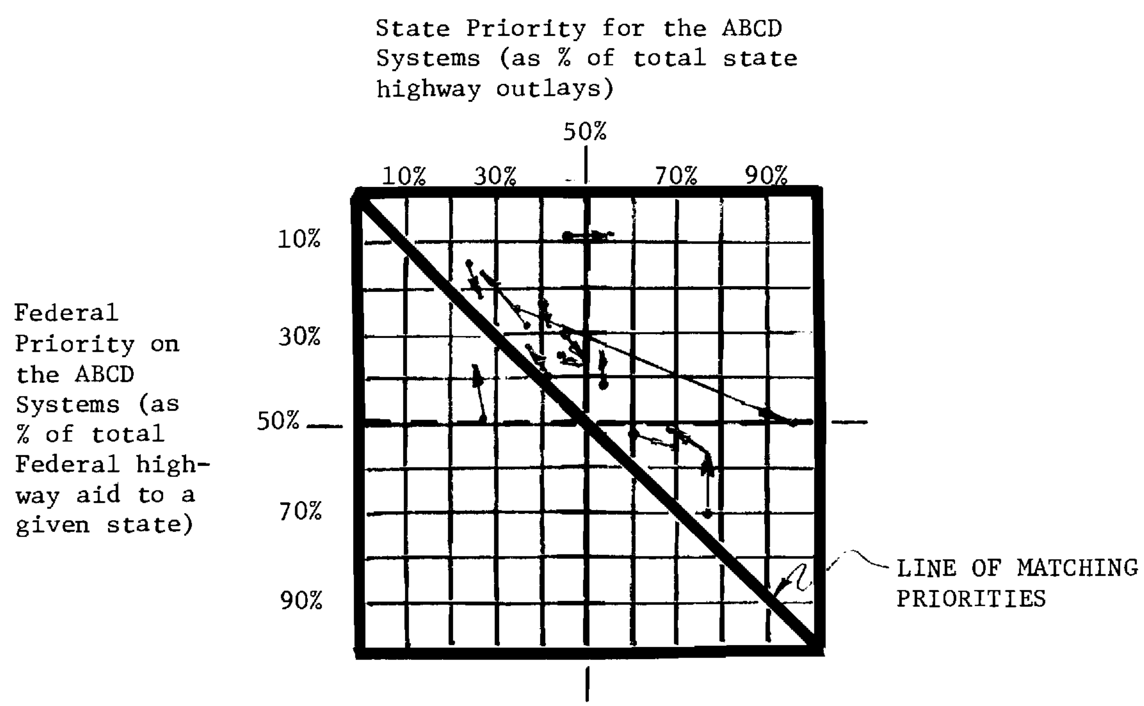


Figure 18. Shift of Each Matcher State as a Result of the 73/74 Matching Ratio Change

We postulate, however, that matchers' priorities did not increase as a result of the 73/74 matching ratio change. We use Figure 18 to consider this. Each matcher state's position in the priority plane before the ratio change is shown by the tail of an arrow; each position after the ratio change is shown by the head of the same arrow. Thus the shift due to the policy change for each matcher state is indicated by an arrow. Now if the policy increased the matcher states' ABCD priority level, then all arrows would be directed toward the right of Figure 18. However, Figure 18 shows that state priorities shifted very little on the average, and their aggregate direction seems random. (Note also that the Federal priority itself increased in some cases, while decreasing in others - it was not a uniform shift.) Therefore, we conclude that the 1970 Highway Act did not systematically alter states' emphasis on the ABCD systems. This is not in opposition to the Federal funding intent of the law, which was to support and relieve the recipient states. Had the funding intent been motivation of individual state spending, these results would have been perplexing.

Aspect 3: Using Pre-Change Data and Our Key Variables to Predict Post-Change Expenditures

We now attempt to predict state-by-state shifts in expenditure levels across the matching ratio change. We divide states into four different categories depending on whether they are more or less needy and more or less fiscally capable. We then use "common sense" to predict expenditure level changes for each of the four categories. For example, we postulate that for a "program effect" of less than one, a state with strong fiscal capability and yet great ABCD need will take advantage of the more favorable matching ratio and at least keep its program level from decreasing. On the other hand, a financially strapped state with no great ABCD need may be expected (with a "program effect" of less than one) to decrease its program level if all it wants to do is avoid foregoing any available Federal matching funds on the program in question.

The above procedure was carried out state-by-state using two different sets of key variables. The first set consisted of fiscal capability measure 1 and need measure 2, and the second set consisted of fiscal capability measure 2 and need measure 3. (Recall that NHIPS need data were not available.) The projected post-change expenditure levels were then compared with the actual historic values. The predictions under both cases yielded an almost equal number of correct and incorrect prognostications.

Conclusions on this aspect are difficult. We hope that combining NHIPS needs measures, when available on a state-by-state basis, with Cooper-derived fiscal capability measures will result in a more accurate predictor. Of course, funding intent will be an important consideration. Instances of support and relief as funding intent will likely provide little state stimulation. Other policy instruments will have to be examined.

V. Conclusions and Areas for Further Exploration

In this work we first examined highway funding from three perspectives. These differing viewpoints were used as background to generate a simple model of state response to Federal highway initiatives. Three key variables were identified: program effect, state highway need, and fiscal capability. With respect to the 1970 Highway Act, it was seen that the "depender" states historically just meet their matching requirements, whereas "self-reliant" states exceed theirs. Furthermore, "matcher" states were seen to act randomly in the priority plane as a result of that act. Attempts to predict individual state behavior as a function of the three, key variables were unsuccessful. Enhancements of the model likely to result in increased success include using fiscal capability classifications suggested by Cooper, replacing these needs measures with the more relevant NHIPS data, and explicitly incorporating funding intent of a given policy into the model. It is recommended that these changes be pursued.

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX C

STATISTICAL ANALYSIS OF THE IMPACT OF FEDERAL HIGHWAY AID ON STATE ALLOCATIVE DECISIONS

by

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U.S. Department of Transportation
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16. Abstract This analysis is concerned with the effects of the funding structures of Federal aid highway programs on State allocative decisions. The focus is on changes which have occurred over the last 20 years in Federal aid funding mechanisms and the impact on State highway programs of these changes. This work is part of a broader study that addresses the effects of funding structures across the highway, airport, and transit modes.

The report is structured with each of the discrete analyses available separately as follows:

- Appendix A, Mass Transit
- Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
- Appendix C, Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions
- Appendix D, The Appalachian Development Highway System
- Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
- Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

Page

Summary iii

I. Introduction 1

II. Base Analysis 2

A. Introduction 2

B. Total Highway Expenditure Analysis 4

C. Disaggregate Expenditure Analysis 9

D. Summary 17

III. Analysis of Data Subsets 18

A. Introduction 18

B. Capital Outlay Regressions 24

C. Noncapital Regressions 35

Summary

This analysis is concerned with the effects of the funding structures of federal aid highway programs on state allocative decisions. The focus is on changes which have occurred over the last 20 years in federal aid funding mechanisms and the impact on state highway programs of these changes. This work is part of a broader study for the Office of the Secretary, U.S. Department of Transportation (P. J. Barbato, monitor) that addresses the effects of funding structures across the highway, airport, and transit modes.

This study used regression analysis on a highway data base which covers the time period 1957-1975 and the 48 contiguous states. In addition to analyzing the data base at an aggregate level, particular subsets of the data base, such as certain groups of states and certain time periods, were also examined.

The analysis began by examining the relationship of federal aid with total state highway expenditures. It was found that one dollar of federal aid per capita was associated with an increase in state expenditures for all highway purposes by about 24 cents per capita in the case of Interstate aid and by about 55 cents per capita in the case of ABC aid. In order to talk about federal objectives in aid programs in terms of stimulating or financially helping state highway activities (substitution effect), attention was devoted to the state capital outlays. This analysis showed that one dollar per capita of federal aid related to about 7-8 cents per capita of state expenditures with both the Interstate and the ABC programs. This implies that the Interstate program may have stimulated state capital programs but by no more than statutorily mandated ratios in the aid program. It also implies a mixed effect in the case of ABC aid - there is some stimulation in the sense that state own expenditures are induced to some extent but by nowhere near the statutorily mandated ratios in the aid programs.

By delving into an analysis of subsets of data, such as certain groups of states or certain time periods, it was found that there is considerable variation in the states' response to federal aid. Based on this analysis, it appeared that high federal matching share alone in federal aid programs is not an overwhelming stimulative factor--the effect of the matching share depends on a number of other variables including the amount of federal aid, the availability of state resources, public support for revenue increases, etc. Alternative contexts in which the federal matching share has different effects were examined. It was also concluded that the extent to which a federal program matches perceived highway needs by states is likely to be a significant factor in state allocative decisions. This explanation appears to have a bearing in the declining interest in the Interstate program in the 1970's, in all except the Southern states, and the high interest of the Industrial states in ABCD programs.

For a variety of reasons, it was not possible in the statistical analyses reported here to sort out the individual effects on state capital expenditures of federal aid primary, secondary, and urban programs. It may be possible to examine these effects by analyzing data now available on the number, type, and dollar value of highway capital projects (classified according to federal aid programs) undertaken by each state.

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[1] Federal aid primary (A), secondary (B), and Urban Extension (C) systems are the major non-Interstate highway aid designates.

I. Introduction

This document describes an analysis of state highway expenditures, relating these to federal aid. The purpose of this analysis is to see what effects, if any, changes in structural parameters of federal-aid programs have had on state highway allocative decisions. The analysis data cover the time period 1957-1975 and include all 48 contiguous states. Within these data, three major instances provide opportunity for comparing state allocative decisions:[1]

(1) the establishment of the Highway Trust Fund and major financing of the Interstate System in 1956

(2) the more favorable matching terms available to so-called "Public Land" states for both Interstate and ABC programs.

(3) the introduction of the Appalachian Highway aid to so-called "Appalachian" states in 1965.

The response of the states to the ways in which federal aid becomes available in more favorable terms (such as higher federal matching shares, eligibility for special federal aid programs) in these three instances might provide clues as to how structural funding parameters of federal aid highway programs impact upon states.

The document is organized as follows. The next chapter describes what is referred to as a base analysis. The attempt here is to describe state allocative decisions regarding capital and noncapital expenditures and user taxes used to finance highway programs as functions of independent variables

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[1] While other rather significant changes in the funding structure of federal aid programs have occurred since 1973, the number of data points (observations) available is insufficient to examine the impacts of these changes.

such as income, population density, federal aid available, etc. No attempt is made here to distinguish between states or time periods other than through the independent variables.

Given that states differ markedly in a number of respects, including economic strength and rate of change therein, industrialization, population, terms of federal aid faced, etc., it appeared useful to conduct an analysis of federal aid impacts on certain groups of states. Division of the 1957-1975 time period to subsets also appeared useful so that one could compare impacts of federal aid, say, ex-ante and ex-post the National Environmental Policy Act (NEPA). These analyses are described in Chapter III.

II. Base Analysis

A. Introduction

We have termed 1957-70 as the base period since analysis of the 48-state response over this period can be compared with the findings by Sherman[1] (whose analysis is over the same period) and by the Rand study[2] (which used data from 1959-70). Of greater interest is the response of particular groups of states (such as Public Land and Appalachian) over particular time periods (such as 1957-65, 1970-75, etc.). These responses are described in the next chapter after a description of the base analysis.

The purpose of this analysis was to examine the impact of federal aid highway programs on state expenditures by function. State expenditures can be

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[1] Sherman, L. The Impacts of the Federal Aid Highway Program on State and Local Highway Expenditures, U.S. Department of Transportation, Washington, D.C., Feb. 1975.

[2] Enns, J. H. The Response of State Highway Expenditures and Revenues to Federal Grants-in-Aid, The Rand Corporation, R-1233-FF, Santa Monica, Calif., Feb. 1974.

categorized in several ways:

- capital expenditures which include resources used for planning, engineering, and building roads (as well as for reconstruction or replacement of roads and bridges so long as such work is deemed capital improvement rather than maintenance)
- maintenance expenditures including the subvention made to local jurisdictions for road maintenance purposes
- administrative and traffic policing expenditures
- noncapital expenditures which include all activities except capital improvements.

The impact of federal aid on state highway revenues derived from fuel taxes, motor vehicle related fees, and other road user levies was also of interest. In this connection, one could think of federal aid being used to lower or maintain state user taxes or, alternately, federal aid could stimulate state highway expenditures necessitating increases in road user taxes.

Federal aid was represented in the analysis by three-year moving averages of apportionments. The federal aid programs were characterized in several ways:

- total federal aid
- federal aid for the Interstate System
- federal aid for the ABC System (or non-Interstate)
- federal aid for the primary (A) System
- federal aid for the secondary (B) System
- federal aid for the urban extensions (C) System.

Efforts to disaggregate the impact of federal ABC aid by its system components were not usually successful. This was due to the confounding that results when states transfer available funds from one category to another, or when states transfer roads from one federal-aid system to another, and due to problems of multicollinearity.

Multiple regression techniques were used in the analysis. A comparison of regression coefficients via ordinary least squares (OLS) and generalized least squares (GLS), where in the latter variables were transformed to account for serial correlation, did not show much difference in the base analysis. Hence in all subsequent analysis, reported in the next chapter, only OLS was employed.

B. Total Highway Expenditure Analysis

Initially, attention was focused on the impact of federal aid on total state highway expenditures, for both capital and noncapital (maintenance, administration, safety, and licensing, etc.) purposes. Sherman had performed an analysis in this way and his work was thought to provide a starting point for this study.

Two regression models were used in this analysis. The first was the one used by Sherman and consisted of the following independent variables: population (SPOP), capital stock (KSTK, a variable constructed by Sherman to represent the highway plant in each state and the dollar needs it generates for improvement and preservation), extent of local involvement, vis-a-vis state, in highway responsibilities (RLTOT), GINI index measuring distribution of income in each state (GINI),[1] extent of toll financing (TOLPCT), degree

[1] The GINI index is a measure of the degree to which income is unequally distributed over the population. The index varies between zero and unity with higher values indicating greater degree of income inequality.

of urbanization (UFAC), per capita income (PCY), and federal aid terms. The federal aid was represented by two terms, Interstate (AVIGP) and non-Interstate (AVNIGP).

The second regression model consisted of population density (POPDEN), extent of bond financing (BIPTCX), and motor fuel consumption (MFC), as well as UFAC, PCY, AVIGP, and AVNIGP defined previously. In both models all dollar terms were deflated according to either the Consumer Price Index, the Federal Highway Administration's (FHWA) construction price index, or the FHWA operation and maintenance price index, as applicable. Also, all terms except ratios were converted to per capita measures.

Two dependent variables were used. The first was the total highway expenditure by states (TOTHWYX) and the second was state only total highway expenditures (STOTHX). The latter is simply the former less federal payments.

Table 1 shows the results of three regression runs and, for comparative purposes, also lists Sherman's findings.[1] In our analysis, all three regression equations yield results which are similar although the second regression model (with the fewer independent variables), shown in regression columns (1) and (2), performed slightly better with respect to $\bar{R}^2$, the proportion of error variance explained by independent variables. Regression column (3) using Sherman's regression model terms is not too dissimilar from Sherman's own results shown in regression column (4) except for the federal aid terms.[2]

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[1]The Rand study's findings are not presented here because they (a) involved a different dependent variable and (b) employed different independent variables. The study represented the federal aid by a single term--total aid--and did not segregate the aid by system category. The Rand study's findings regarding the federal aid coefficient are discussed later.

[2]Differences in the coefficient estimates of KSTK and TOLPCT are likely due to the use of different dimensions. For example, KSTK in our analysis is in dollar terms while in Sherman's analysis it is probably in thousands of dollars.

Table 1. Regression of State Expenditures for All Highway Purposes on Base Data

	DEPENDENT VARIABLE							
	Our Analysis						Sherman[a]	
	(1) TOTHWYX		(2) STOTHX		(3) STOTHX		(4) STOTHX	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
Independent Variables								
AVIGP	1.2398	0.0704	0.3905	0.0531	0.1114	0.0717	0.642	0.045
AVNIGP	1.5440	0.1965	0.5561	0.1483	0.5532	0.1453	- 1.103	0.092
UFAC	- 0.4562	0.0560	- 0.4521	0.0422	- 0.3052	0.0465	- 0.738	0.040
PCY	0.0119	0.0019	0.0120	0.0014	0.0103	0.0016	0.022	0.001
POPDEN	- 0.0268	0.0052	- 0.0262	0.0014	--	--	--	--
BIPTCX	0.3595	0.0242	0.3839	0.0182	--	--	--	--
MFC	- 0.0006	0.0116	- 0.0140	0.0087	--	--	--	--
SPOP	--	--	--	--	-4.2×10^{-7}	1.7×10^{-7}	-8.6×10^{-7}	9.4×10^{-8}
KSTK	--	--	--	--	0.0005	0.003	8.028	1.050
RLTOT	--	--	--	--	- 0.7578	0.0857	- 0.430	0.046
GINI	--	--			0.1463	0.1006	0.771	0.159
TOLPCT	--	--			631.7749	51.6233	0.598	0.089
Constant	37.4440	3.8897	38.7541	2.9344	72.8581	5.9645	12.12	7.16
$\overline{R}^2$	0.73		0.56		0.51		0.77	

[a]Source: Sherman, L. op. cit., p. 264.

The coefficients of the federal aid terms are consistent in our analysis in all three regression runs. The first run with total state highway expenditures as the dependent variable yields coefficient estimates of 1.24 for Interstate aid and 1.54 for ABC aid. This indicates that, on the average, one dollar of Interstate aid per capita was associated with an increase in total state highway expenditure (including the federal aid) by $1.24 per capita, or an additional state expenditure of 24 cents per capita. Similarly, one dollar of ABC aid per capita is associated with a state-own expenditure of 54 cents per capita for all highway purposes. This result for the ABC aid holds in the second and third regressions where the dependent variable is state-only total highway expenditures, i.e., the state expenditures for all highway purposes but excluding federal payments. Results are slightly different for the effect of Interstate aid.

The most puzzling result in Table 1 is the difference in coefficients of federal aid terms between our and Sherman's analyses. This difference is marked in the case of ABC aid. Sherman's coefficient of -1.103 (which is statistically not different from -1) implies that one dollar of ABC aid per capita leads to a reduction in state highway expenditures of one dollar per capita so that total state highway expenditures (including federal aid) would not change at all.[1] Our results show that one dollar of ABC aid per capita would increase state highway expenditures by 55 cents per capita for a total increase of $1.55 per capita.

There are some differences between our analysis as represented by regression column (3) and Sherman's analysis. First, Sherman deflated all dollar terms according to the Consumer Price Index and expressed them in constant 1970 dollars. We used 1967 as base and three different price

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[1]Interpretation of the negative coefficient is addressed by Porter, A. L. and Park, C. Y. in their companion paper on the Appalachian Development Highway System (Appendix D).

deflators as explained previously. Sherman also introduced certain variables (population and degree of urbanization) with a one year lag while we did not. These differences in the treatment of the independent variables might be expected to cause some variation in the findings, although we would not have expected such profound differences in the federal aid terms.

In subsequent analyses we abandoned the use of total state highway expenditures as the dependent variable. Instead, we used state capital outlay as the variable to be explained. The idea here is that while it is interesting to look at the effects of federal aid on total highway expenditure, objectives of federal aid programs are generally expressed in terms of highway capital programs. For example, the purpose of the Interstate program was to induce and accelerate state construction of these Interstate highways. The question to ask then is to what extent did this occur? To be sure, federal aid programs will also affect other state programs--maintenance expenditures can be expected to increase as more highways are built and administrative expenses may also go up with federal aid. But the primary stimulative, substitutive,or other type of effect of federal aid can most meaningfully be discussed in terms of state capital programs.

We also decided not to subtract federal payments from state (capital) expenditures. Federal payments are generally reimbursements for state costs incurred in the past. Although such payments may affect cash flow (however, states can address this through short term notes), by and large, state decisions on capital outlay in a given year can be expected to be based on perceived highway needs and anticipated federal aid (i.e., apportionments) and the terms of such aid (level of apportionment, matching ratio, etc.). Federal payments received for capital projects completed earlier may not be good indicators of the federal costs of capital projects anticipated to be undertaken in the future.

C. Disaggregate Expenditure Analysis

In addition to looking at the impact of federal aid on state capital programs, we also did separate analyses of state allocative decisions regarding expenditures for maintenance, administration, and noncapital purposes in general, and also regarding revenues derived from highway user charges. Several regression models were tested here and the seven models ultimately used are described below with error terms omitted for clarity:

$$\text{CAPOUT} = a_0 + a_1 * \text{UFAC} + a_2 * \text{PCY} + a_3 * \text{POPDEN} + a_4 * \text{BIPTCX} + a_5 * \text{MFC} + a_6 * \text{AVIGP} + a_7 * \text{AVNIGP} \quad (1)$$

$$\text{CAPOUT} = b_0 + b_1 * \text{UFAC} + b_2 * \text{PCY} + b_3 * \text{POPDEN} + b_4 * \text{BIPTCX} + b_5 * \text{MFC} + b_6 * \text{AVAGP} + b_7 * \text{AVBGP} + b_8 * \text{AVCGP} + b_9 * \text{AVIGP} \quad (2)$$

$$\text{CAPOUT} = c_0 + c_1 * \text{UFAC} + c_2 * \text{PCY} + c_3 * \text{POPDEN} + c_4 * \text{BIPTCX} + c_5 * \text{MFC} + c_6 * \text{AVTGP} \quad (3)$$

$$\text{MN\&LOCX} = d_0 + d_1 * \text{UFAC} + d_2 * \text{PCY} + d_3 * \text{POPDEN} + d_4 * \text{BIPTCX} + d_5 * \text{RLTOT} + d_6 * \text{SNOW} \quad (4)$$

$$\text{ADMINX} = e_0 + e_1 * \text{UFAC} + e_2 * \text{PCY} + e_3 * \text{POPDEN} + e_4 * \text{BIPTCX} + e_5 * \text{RLTOT} + e_6 * \text{AVTGP} \quad (5)$$

$$\text{NONCAPX} = f_0 + f_1 * \text{UFAC} + f_2 * \text{PCY} + f_3 * \text{POPDEN} + f_4 * \text{BIPTCX} + f_5 * \text{RLTOT} + f_6 * \text{SNOW} + f_7 * \text{AVTGP} \quad (6)$$

$$\text{USERREV} = g_0 + g_1 * \text{NONCAPX} + g_2 * \text{PCY} + g_3 * \text{SOCONSTX} + g_4 * \text{BIPTCX} \quad (7)$$

where

CAPOUT	=	per capita state capital outlay
MN&LOCX	=	per capita state maintenance expenditures and grants-in-aid to local jurisdictions
ADMINX	=	per capita state administrative and traffic police expenditures
NONCAPX	=	per capita noncapital state highway expenditures
USERREV	=	per capita state highway revenues from road user taxes and fees
UFAC	=	urbanization factor--the percentage of population residing in urban areas
PCY	=	per capital income
POPDEN	=	population density
BIPTCX	=	expenses for bond interest and retirement as a percentage of total capital expenditures
MFC	=	per capital motor fuel consumption
AVIGP	=	per capita federal interstate apportionment (moving average)
AVNIGP	=	per capita federal noninterstate apportionment (moving average)
AVAGP	=	per capita federal primary apportionment (moving average)

AVBGP = per capita federal secondary apportionment (moving average)

AVCGP = per capita federal urban extension apportionment (moving average)

AVTGP = per capita federal total apportionment (moving average)

RLTOT = local governments' general expenditure as a percentage of general expenditure by state and local governments

SNOW = average annual snowfall in inches

SOCONSTX = per capita state capital outlay exclusive of federal aid

The form of the regression models (the seven equations and the variables) were influenced by the Rand Study while the disaggregation of federal aid terms was suggested by Sherman's analysis. All dollar terms were deflated according to either the Consumer Price Index, Federal Highway Administration's (FHWA) construction price index, or FHWA operation and maintenance price index as appropriate.

The seven regression equation results in the base analysis are shown in Table 2. The standard error is shown in parentheses beneath each regression coefficient.

Turning first to the impact of federal aid on state capital outlay, the coefficients suggest that the overall effect of one dollar per capita of federal aid is to elicit a matching expenditure of eight cents for a total increase in state capital outlay of $1.08 per capita. This is consistent with the Rand Study's finding of $1.01 to $1.05 while Sherman found that state total highway expenditure would increase by $1.04 per capita from a one dollar increase in federal aid.

The magnitude of the induced effect on state capital expenditures is the same in absolute terms with the Interstate and ABC programs; the increase

Table 2. Base Analysis Results, 48-States 1957-1970[a]; 1967 Constant Dollars

Independent Variable	Variable Description	CAPOUT	CAPOUT	CAPOUT	MN&LOCX	ADMINX	NONCAPX	USERREV
Constant		17.514	16.201	17.505	23.256	4.855	37.985	18.712
		(2.861)	(3.782)	(2.854)	(.927)	(.605)	(2.428)	(1.282)
UFAC	urbanization	- 0.141	- 0.178	- 0.141	- 0.049	-0.031	- 0.218	--
		(.041)	(.050)	(.041)	(.012)	(.007)	(.027)	--
PCY	income	0.001	0.001	0.001	0.002	.003	0.009	0.002
		(.001)	(.001)	(.001)	(.0003)	(.0001)	(.001)	(.0005)
POPDEN	population density	0.001	- 0.000	0.001	- .005	- .002	- 0.025	--
		(.004)	(.004)	(.004)	(.001)	(.001)	(.002)	--
BIPTCX	debt payments	- 0.030	- 0.028	- 0.030	0.023	0.010	0.368	- 0.183
		(.018)	(.018)	(.018)	(.005)	(.003)	(.012)	(.009)
MFC	fuel consumption	0.012	0.018	0.012	--	--	--	--
		(.009)	(.010)	(.008)	--	--	--	--
RLTOT	local expenditure	--	--	--	0.702	-0.115	- 0.422	--
		--	--	--	(.016)	(.010)	(.041)	--
SNOW	snowfall	--	--	--	0.061	--	0.080	--
		--	--	--	(.006)	--	(.014)	--
NONCAPX	noncapital	--	--	--	--	--	--	0.472
		--	--	--	--	--	--	(.018)
SOCONSTX	state only capital	--	--	--	--	--	--	0.223
		--	--	--	--	--	--	(.031)
AVTGP	total federal aid	--	--	1.081	--	0.069	0.098	--
		--	--	(.033)	--	(.005)	(.020)	--
AVIGP	Interstate aid	1.083	1.082	--	--	--	--	--
		(.052)	(.052)	--	--	--	--	--
AVNIGP	non-Interstate aid	1.074	--	--	--	--	--	--
		(.145)	--	--	--	--	--	--
AVAGP	primary aid	--	1.902	--	--	--	--	--
		--	(.882)	--	--	--	--	--
AVBGP	secondary aid	--	- 0.234	--	--	--	--	--
		--	(1.298)	--	--	--	--	--
AVCGP	urban aid	--	3.400	--	--	--	--	--
		--	(2.387)	--	--	--	--	--
$\bar{R}^2$		.76	.76	.76	.80	.60	.73	.67

[a]Numbers in parentheses give standard errors.

in state capital outlay per unit increase in federal aid is $1.08 and $1.07, respectively. With the Interstate program, given the statutory matching ratio of 90:10 federal to state, one might expect one dollar of federal aid to lead to an increase in expenditure of $1.11 (found as 100÷90). However, it should be noted that since the matching ratio is more favorable to the Public Land States--as high as 95:5 federal to state--the overall average increase in expenditure to be expected should be less than $1.11 but greater than $1.05 (found as 100÷95). With the ABC programs where the statutory matching ratio was generally 50:50, one dollar of federal aid should increase state expenditure by two dollars.[1]

If the point estimates for the Interstate and ABC terms are taken at face value, this suggests that states responded to the Interstate aid in the statutorily expected manner, increasing the expenditure from their own sources in proportion to the required matching share. With the ABC programs, on the other hand, it would appear that states were engaged in a substantial substitution of the federal aid for own resources which might have been spent in the absence of the federal aid. (While these interpretations are interesting, it should be cautioned that with neither the Interstate nor the ABC terms are the regression coefficients statistically different from one.) Sherman, on the other hand, found that one dollar of Interstate aid would induce an increase of $1.60 in the <u>total</u> state highway expenditure (i.e., would draw 60 cents from state's own resources) while one dollar of ABC aid would not lead to any increase in <u>total</u> state highway expenditure at all (i.e., would lead states to reduce their own expenditure by one dollar). Therefore, Sherman concluded that the Interstate program had a

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[1]With the exception of Public Land States--they receive more favorable terms.

substantial stimulative effect on the total highway expenditures of states and that the ABC program led to a perfect (one for one) substitution response. If the point estimates in our analysis are taken at face value, they would suggest that the Interstate program had a stimulative effect on state capital expenditures, but by no more than the statutorily mandated amounts and that the ABC program had a mixed (somewhat stimulative and somewhat substitutive) effect in the sense that state capital outlay (including federal aid) increased but by nowhere near the statutorily mandated ratios.[1]

The third regression model attempted to disaggregate the impact of ABC aid. The primary system coefficient had a point estimate of 1.902, close to the statutorily mandated ratio, although it was not statistically different from one. The secondary system coefficient was puzzling with a point estimate of -0.234 but with such a large standard error that the 95 percent confidence interval ranges from -\$2.78 to \$2.31. Such a large interval precludes drawing useful conclusions. The urban extensions system coefficient behaved in the same way. These problems are due to multicollinearity, a condition which arises when some of the independent variables are closely related.[2] In this case, the federal apportionments

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[1] One possibility for reconciling these differences is the hypothesis that the Interstate program also led to a stimulative effect on noncapital expenditures and that the ABC program had a depressive effect on noncapital expenditures. This hypothesis has not been tested here and may be worth future exploration.

[2] One indicator of this problem is the determinant of the correlation matrix of independent variables. A value of one indicates perfect orthogonality while a value of zero indicates perfect multicollinearity. This determinant had a value of 0.08, 0.03, and 0.0002 in the third, first, and second regressions respectively. When the determinant gets very small, the precision involved in inverting the correlation matrix becomes small. This leads to large standard errors for the regression coefficients. When some of the independent variables are perfectly correlated, the correlation matrix cannot be inverted at all and statistical regression becomes infeasible. This condition is referred to as perfect multicollinearity.

for the A, B, and C systems are highly correlated with each other since they were often authorized by Congress in fixed proportions (such as 45, 30, 25 percent of the total ABC authorization for A, B, and C systems, respectively).

The coefficients of the other independent variables in the capital outlay regressions had the expected signs and were comparable to the estimates obtained by the Rand Study. The urbanization factor was highly significant, and its negative sign indicates that the per capita capital outlay is relatively lower in the urbanized states, ceteris paribus. Population density was not statistically significant, probably because the presence of the urbanization factor makes it redundant. BIPTCX, which indicates the relative magnitude of the highway debt retirement and interest expenses, had a minus sign indicating that the higher this debt, the lower the propensity to further increase it by bond-financed construction. Motor fuel consumption had a positive sign; high fuel consumption implying increased vehicle miles of travel leads to increases in fuel tax revenues available and to greater demand for new and improved roads.

The fourth regression equation examined state outlays for maintenance purposes. All of the independent variables were highly significant. Urbanization factor and population density had the expected negative signs suggesting economies of scale in larger, more concentrated operations. The amount of snowfall had the expected positive sign--maintenance costs are higher in the "snow-belt" states due both to snow removal and ice prevention costs and to the increased rate of road deterioration. Per capita income had a positive sign and so did RLTOT, the ratio of local to state and local expenditures. The RLTOT variable was put in to account for the differences among states in the division of state versus local responsibilities regarding the provision of general services. The positive coefficient can be interpreted to mean that where local governments have considerable responsibilities, increased aid from state to local jurisdictions can be expected. The positive sign might also suggest that where local governments have relatively greater responsibilities, the state is able to spend more for maintenance on state-owned roads. BIPTCX also had a positive sign. There are a number of forces at act here. On the one hand large highway debts might be expected to drain current revenues leading to lower maintenance expenditures. On the other hand, funding highway capital programs through bonds (especially revenue bonds) would spare current revenues for maintenance (and lead to increased maintenance responsibilities in the long run as the highway systems are expanded). On balance, it appears that incurrence of higher debt had a positive effect on maintenance expenditures. However, this relationship may change in the future as more and more of the debt (incurred largely in the 1960's and 1970's) must be retired in the near future.

The fifth regression equation examined state outlays for administration and traffic police services. All of the independent variables were again highly significant. Urbanization factor and population density as before had negative signs suggesting certain economies of scale. Per capita income and BIPTCX had positive signs as before. RLTOT, however, had a minus sign indicating lower administrative expenses when local governments assume larger roles in the provision of public services. Finally, one dollar of federal aid per capita (for capital improvements) had a positive effect on administrative and policing expenses increasing them by about 7 cents per capita. Greater federal aid makes for more administrative work in processing grants, administering them, and complying with the regulations.[1]

The sixth regression equation examined state outlays for noncapital purposes. The results here are generally similar to what would be expected by examining the fourth and fifth regressions together.[2] The federal aid term has a coefficient of 0.098 indicating that one dollar of federal aid for capital purposes is associated with an increase in state outlay for noncapital purposes of about 10 cents per capita.

The final regression equation examined state highway revenues derived from user taxes and fees. All of the independent variables were highly significant and had the expected signs. User revenues increased with income, noncapital highway expenditures, and capital expenditures from own resources. However, user revenues decreased as greater reliance was placed on funding capital programs from bonds. As in the case of the maintenance regression equation, this relationship may change in the future as increasing revenues are required for retiring highway debt.

D. Summary

In summary, this base analysis indicates that over the 1957-70 period, the response of the 48 states in their highway capital program can be characterized as stimulative in the case of federal Interstate aid and mixed

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[1]Note that all of the dollar terms in these regressions are in 1967 constant dollars. In today's dollars, the impact of federal aid on administrative and policing expenses would be considerably higher than indicated.

[2]It should be cautioned that NONCAPX was constructed by subtracting CAPOUT (state capital outlay) from TOTHWYX (state total highway expenditure) after both variables had been deflated. The first variable, CAPOUT, had been deflated according to the construction price index while the second variable, TOTHWYX, had been deflated according to the operation and maintenance price index. Thus the NONCAPX obtained is different from what would be obtained if CAPOUT had been subtracted from TOTHWYX before deflating and then deflating the result by the operation and maintenance index.

with the federal ABC aid. Overall, federal aid appears to have had a mildly stimulative effect on state capital programs. In addition, federal aid for capital purposes has also led to an increase in noncapital expenditures and highway user tax revenues.[1]

The next chapter undertakes an analysis of federal aid impacts on different groups of states and in different time periods. This analysis shows that the state highway programs are quite heterogeneous and have responded in different ways to the terms of federal aid made available under the differing prevailing circumstances of the times.

III. Analysis of Data Subsets

A. Introduction

In this chapter we undertake an analysis of certain subsets of data. The entire data base includes all 48 contiguous states and covers the time period 1957-75. It was thought that by separating this data base into subsets and by comparing the analytical results on appropriate subsets, it might be possible to infer the differential impacts of funding structures of federal aid programs.

In the formulation of data subsets to achieve this purpose we account for the fact that:

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[1] One dollar of federal aid would induce an 8 cent increase in state capital outlay from own sources. The latter in turn leads to a 22 percent increase in state user tax revenues. The net effect of one dollar of federal aid on user revenues is thus an increase of about two cents per capita.

- the policy variables of interest--terms of federal aid--have been different for certain groups of states (for example, Public Land and Appalachian States)
- certain other external variables such as the economic recession in the late 1950s and early 1970s, the environmental movement in the 1970s, etc., are potential confounding factors.

One dimension in the formulation of data subsets was state grouping--identification of distinct groups of states with each group having some common element. Considering first the terms of federal aid, we identified four state groups as follows:

Diminutive States: In order to assure that all states would be guaranteed certain minimum sums of federal aid in undertaking capital projects, Congress decreed that for certain types of federal aid, no state shall receive less than ½ of 1 percent of the annual appropriation. States qualifying for this provision, Delaware, New Hampshire, Rhode Island, and Vermont, are therefore eligible for much more federal aid than they would receive under the conventional apportionment formula.

Public Land States: Many of the large western states have considerable amounts of publicly-owned lands (e.g., Indian lands) which are nontaxable. To compensate for this, Congress decreed more favorable terms of federal aid (higher federal share of project costs) for these states than apply to the rest of the states. Of the 48 contiguous states, 12 are classified as Public Land States.

Appalachian States: In 1965 Congress established the Appalachian Regional Commission. The commission administers the funding of the Appalachian Development Highway System (ADHS) and the Appalachian Local Access Roads Program.[1] Thirteen states in the Appalachian corridor are eligible for these programs which are financed out of general funds. The federal-state matching share provisions in these programs have generally been the same as in the ABC programs.[2]

Core Appalachian States: The five Appalachian states with substantial participation in the ADHS Program are termed "core." Their behavior may differ substantially from that of the rest of the Appalachian states.

Noncore Appalachian States: The eight Appalachian States not included above constitute this group. Some of these states were late comers into the ADHS Program and some such as Pennsylvania, Ohio, and New York are industrial states where the ADHS Program may be a relatively small part of the total highway capital program.

Other States: The remaining 19 states not included in the above five categories were treated as a single group for comparison purposes.

In order to develop a better appreciation for the effects of external factors, the 48 states were subdivided into three different groups following Luttbeg.[3] These were as follows:[4]

---

[1]Of the two programs, ADHS accounts for about 95 percent of the funds.

[2]Except that for two-lane road projects, the federal matching share had been set at a maximum of 70 percent from the outset.

[3]Luttbeg, N. R., "Classifying the American States: An Empirical Attempt to Identify Internal Variations," The Midwest Journal of Political Science, Vol. XV, Nov. 1971, pp. 703-721.

[4]Luttbeg's fourth grouping called Frontier States, and consisting of Alaska (not in our data base) and Nevada, did not provide enough observations for regression analysis on this group.

- Industrial States
- Sparsely Populated States
- Southern States.

The second dimension used in the formulation of data subsets was time period--data for selected years were pooled together. The idea here was to divide the 19-year time period represented in the data (1957-1975) into subsets which when compared could provide some useful inferences about how certain major events, such as the introduction of the ADHS Program or the environmental movement, affected state allocative decisions. In order to assist in defining these time periods, an analysis was carried out year by year. In this analysis, state capital outlay per capita was regressed on a number of variables with the federal aid represented by a single grant variable (the regression model used was the third equation described in Chapter II).[1] The regression coefficient estimates of the federal grant term, AVTGP, are shown plotted in Figure 1. The results show at least three distinct time periods: (1) the second half of the fifties; (2) the first half of the sixties; and (3) the years following the mid-sixties. Based on these results as well as those from regression equations with multiple grant terms (which were generally, but not always, plagued with problems of collinearity), four time periods were selected: (1) 1957-1961; (2) 1962-1966; (3) 1967-1970; and (4) 1971-1975.

Thus, nine groups of states, displayed in Table 3 and four time periods yielded a total of 36 data subsets for analysis. In order to provide a base for comparing the results of these 36 data subsets, another series of analyses was carried on all 48 states over each of the four time periods.

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[1]Since this analysis included only cross-sectional data and no time series, the problem of collinearity became acute when the federal aid was represented by more than one variable.

Figure 1. Federal Aid Coefficients in Capital Outlay Regressions by Year

Table 3. State Groupings

Dimunitive	DE, NH, RI, VT
Public Land	AZ, CA, CO, ID, MT, NV, NM, OR, SD, UT, WA, WY
Appalachian	AL, GA, KY, MD, MS, NY, NC, OH, PA, SC, TN, VA, WV
Core Appalachian	KY, NC, TN, VA, WV
Noncore Appalachian	AL, GA, MD, MS, NY, OH, PA, SC
Other	AR, CT, FL, IL, IN, IA, KS, LA, ME, MA, MI, MN, MO, NE, NJ, ND, OK, TX, WI
Industrial	CA, CT, DE, IL, IN, ME, MD, MA, MI, MN, NJ, NY, OH, PA, RI, WA, WI
Sparsely Populated	CO, ID, IA, KS, MT, NE, NH, ND, OR, SD, UT, VT, WY
Southern	AL, AZ, AR, FL, GA, KY, LA, MS, MO, NM, NC, OK, SC, TN, TX, VA, WV

In each of these analyses, the regression equations described in the previous chapter were estimated, although the second equation attempting to disaggregate ABC federal aid impacts is not reported here since it encountered problems of multi-collinearity. In the following sections we discuss those results which appeared to be interesting.

B. Capital Outlay Regressions

The two capital outlay regressions, one with federal aid represented by a single grant term (AVTGP) and the other with federal aid separated into an Interstate term (AVIGP) and an ABC term (AVNIGP) are shown in Table 4. Only the coefficients of the federal aid terms in the 80 regressions (2 regressions on 40 data subsets) are shown since these are of primary interest and since showing the complete results would occupy immense space.[1]

Coefficients which are statistically different from zero at 95 percent significance are noted in the table by asterisks. Coefficients which are not statistically different from zero tend to occur more often when the number of observations (i.e., sample size) is small such as with the Diminutive States data subsets. In these cases, the coefficients are also usually not statistically different from other values such as 1 or 2 so that nothing meaningful can be said here about the relationship between federal aid and state capital outlay decisions.

One of the interesting results in Table 4 is the size of the federal aid terms, particularly Interstate, in the 1957-61 regressions. Practically all of these coefficients are less than one. It might have been thought that state capital outlays would have been strongly stimulated by the accelerated financing of the Interstate System in 1956. However, the results

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[1]However, the complete results are available upon request.

Table 4. Federal Aid Coefficients in Capital Outlay Regressions in Analysis of Data Subsets

	Total Federal Aid AVTGP				Interstate Aid AVIGP				ABCD Aid AVNIGP			
	57-61	62-66	67-70	71-75	57-61	62-66	67-70	71-75	57-61	62-66	67-70	71-75
48 States	0.7013*	1.3249*	1.2966*	1.0408*	0.7370*	1.1984*	1.3321*	1.2085*	0.5725*	1.9361*	1.1026*	0.1710
Dimunitive	0.6065*	1.4744*	-0.0312	1.2153*	1.0829*	0.6126	-1.4610	0.4493*	-6.3858*	6.5535	13.8119*	8.8193*
Public Land	0.3243*	1.1501*	1.4178*	1.0005*	0.3497	1.1675*	1.2979*	0.6964*	0.1185	1.0505	1.9008*	2.5189*
Appalachian	0.7732*	1.5281*	1.3096*	1.8612*	0.7255*	1.4985*	1.3054*	1.8046*	1.1673	3.7982	4.3174	4.0690
- Core	0.9206*	0.4823	1.4156*	1.7351*	0.7617	0.4948	1.3398*	1.5046*	2.4874	2.6435	- 3.7766	9.5782
- Noncore	0.5574*	1.1494*	0.7865	1.2510*	0.3913	0.8396*	0.4613	0.7406*	1.6234	4.9373*	6.8983*	7.6753*
Other	0.8922*	0.9230*	0.9463*	0.7499*	0.9193*	0.9693*	1.0150*	0.6612*	0.8053	0.6680	0.6585	1.1632*
Industrial	0.6509*	2.1185*	1.3097*	1.2370*	0.2562	1.8333*	0.9987*	0.8939*	2.2920*	3.4629*	4.3749*	4.6531*
Sparsely Populated	0.9432*	1.2622*	1.4418*	0.8205*	0.6987*	1.1818*	1.4220*	0.6619*	2.1550*	1.7547*	1.6211*	1.9147*
Southern	0.6462*	1.3154*	1.1822*	1.6219*	0.4766*	1.4773*	1.2520*	1.7811*	1.5275	0.4224	0.3487	-1.5745

Asterisk indicates statistically different from zero at 95 percent significance. For the rest of the coefficients the standard errors are so large that it is not possible to reject the hypotheses that either they are zero or that they equal one.

show that for the 48 states as a whole, one dollar of Interstate aid per capita during 1957-61 increased state capital outlay (including federal aid) by only about 74 cents per capita. It is possible that the true impact of the Interstate program in this period is confounded in the regressions by a number of external factors such as the recessions in 1959-60 and the decline in Interstate apportionments in 1961 (of about 28 percent from the previous year in current dollars). A potentially more serious problem concerns the lead time involved in completing highway projects. It may well be that the Interstate program stimulated considerable highway projects in 1957-61, but in, say 1957 or 1958, state capital outlay only reflects a portion of the total costs of these projects--that paid to contractors for completed project phases--and for large Interstate projects which involve four or more years to complete, this lag between the true effect and its manifestation in data can be very important. If this lag indeed occurred, it has implications which go beyond just these regressions. It may mean, for example, that state capital outlays in 1974 and 1975 do not fully reflect the fiscal austerity reported by many states.

For ease of interpretation, some of the results in Table 4 are plotted in Figures 2, 3, and 4. In Figure 2, which shows the profile of total federal aid coefficients (AVTGP), we can see that:

- the response of the Public Land and Appalachian states is quite different from that of the Other states
- the response of the Public Land states is different from (in fact, opposite to) that of the Appalachian states over both the late 1960s and early 1970s
- the response of the Appalachian states is quite similar to that of the Southern states and, over a limited time period, to that of the Industrial states

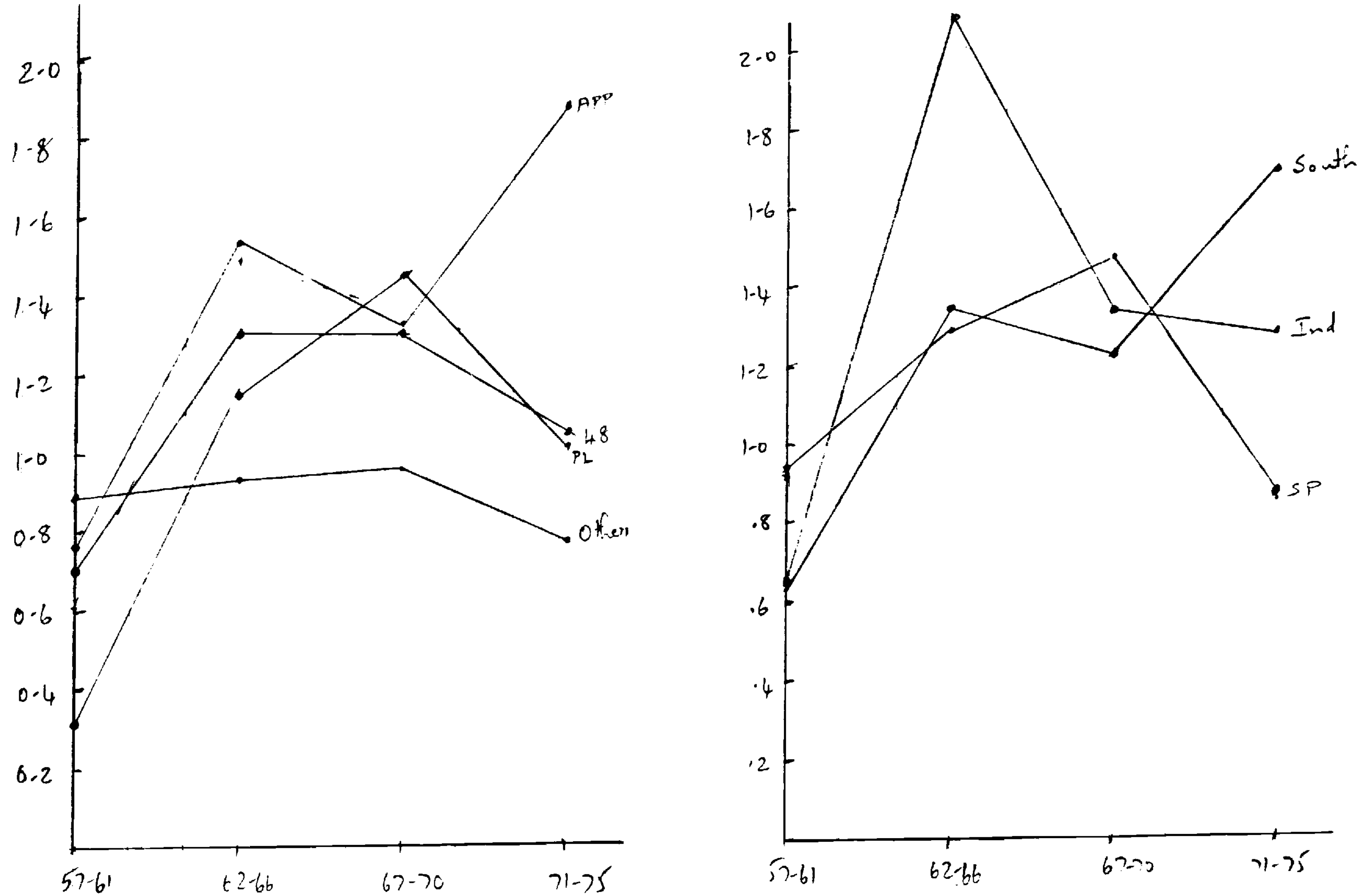

Figure 2. Total Federal Aid Coefficients in Capital Outlay Regressions

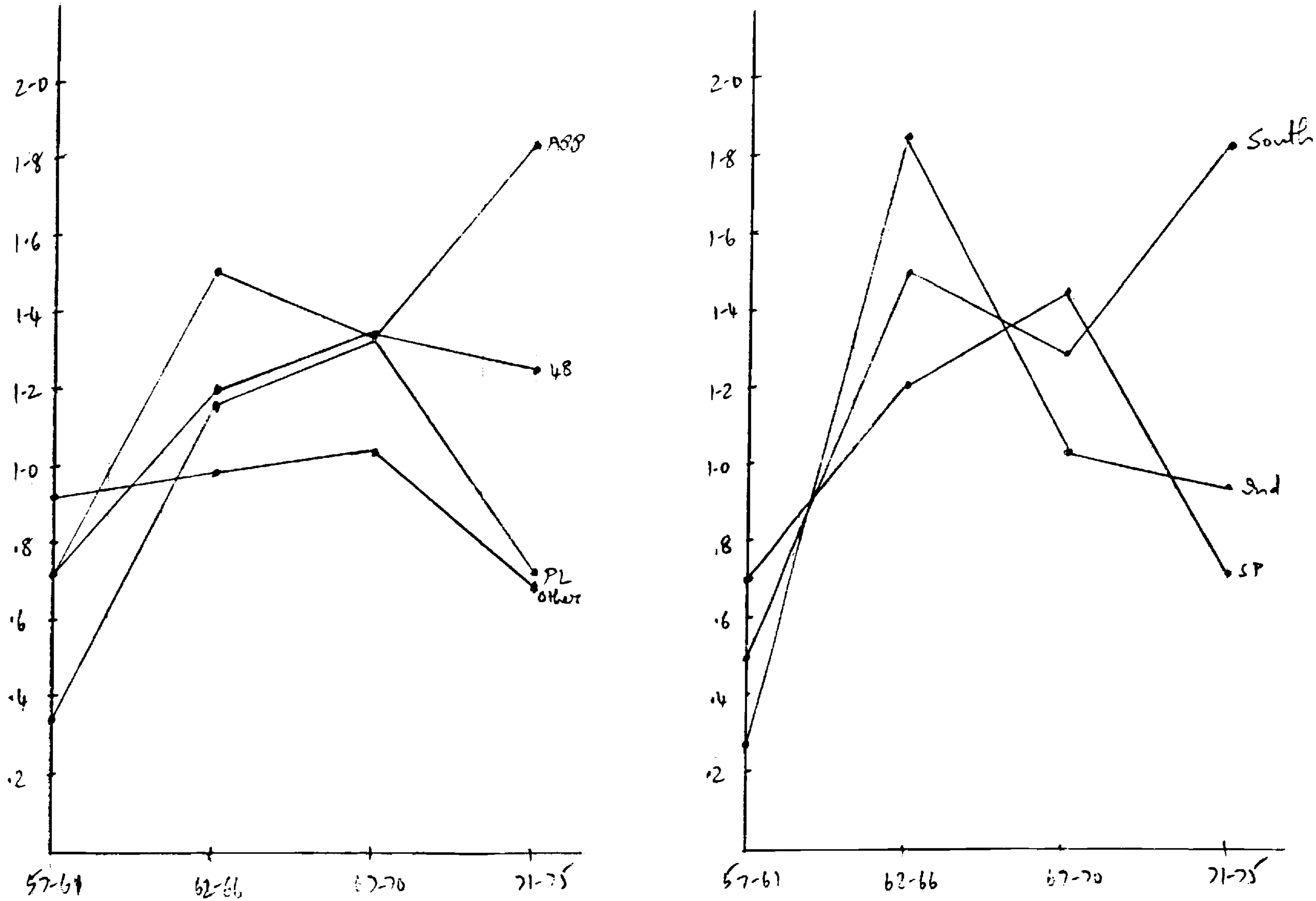

Figure 3. Interstate Aid Coefficients in Capital Outlay Regressions

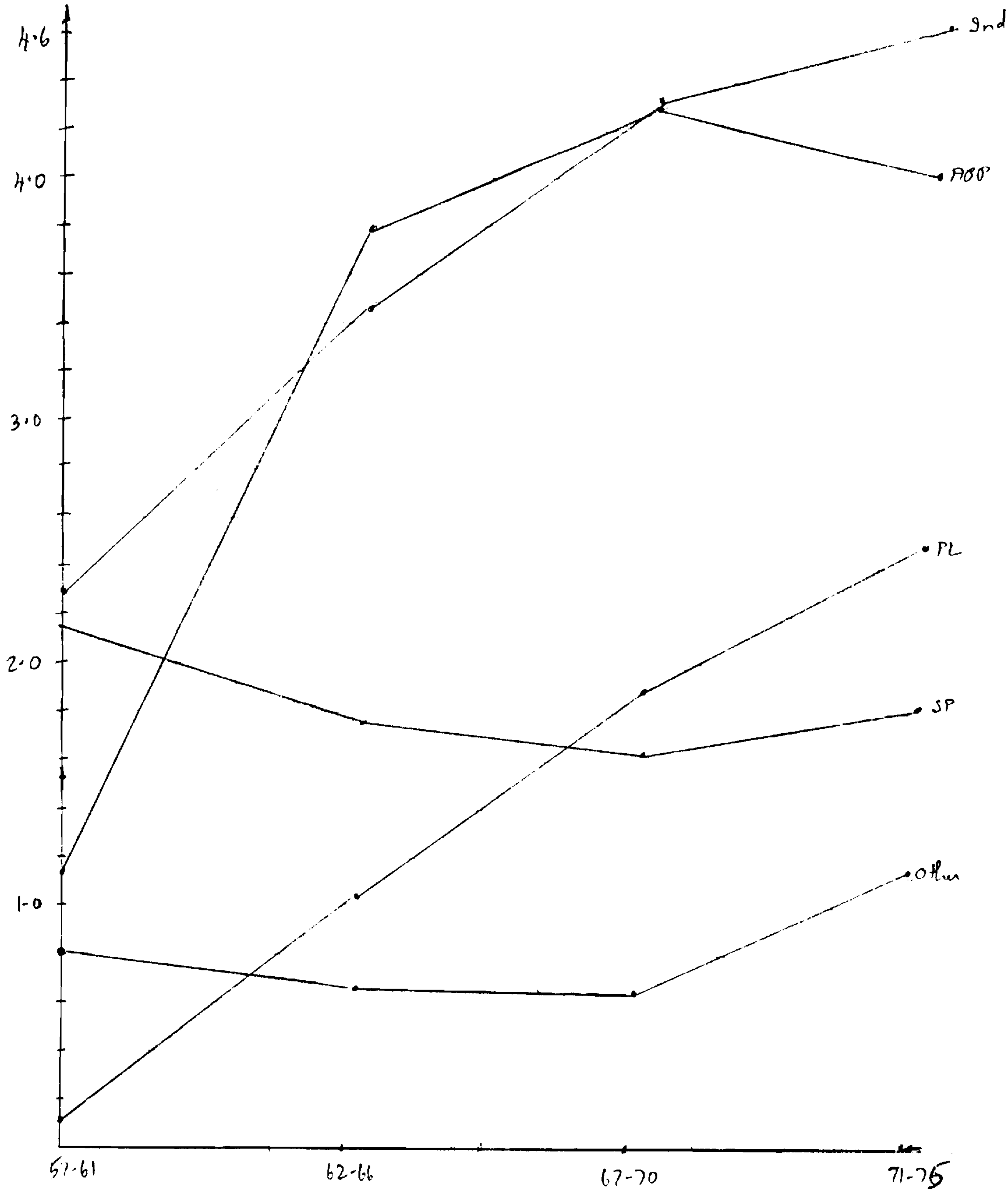

Figure 4. ABCD Aid Coefficients in Capital Outlay Regressions

- the response of the Public Land states is similar to that of the Sparsely Populated states.[1]

In Figure 3 we see that the profile of Interstate aid coefficients (AVIGP) is similar to that of the total federal aid coefficients. From Figure 4, however, the profile of ABCD aid coefficients is different from that of the Interstate aid; we hasten to add that few of the ABCD coefficients were statistically significant and hence it would be prudent not to draw any strong conclusions on the basis of Figure 4.

On the basis of these results, it would appear that high federal matching shares alone do not appear to be an overwhelming stimulative factor in state response. If they were, one would expect the response of the Public Land states, which had better terms of federal aid than the rest of the states, to exhibit higher federal aid coefficients.

To clarify this discussion, consider a state which initially has \$5 million in own resources for capital spending in a particular program (say, the secondary road program). Assume further that the federal aid available is \$24 million of which \$16 million would lapse at the end of the current year if not obligated. Now consider two scenarios, one in which the program carries considerable public support and the other where it does not. Public support is here defined as the willingness to bear <u>additional</u> state highway taxes (or alternately, permission to use bonds) and thereby make available additional resources. Assume that on both engineering and economic grounds deficiencies exist on the secondary road system, and that road improvements within available resources are deemed desirable.

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[1]Note that these groups are not mutually exclusive sets of states. For example, many of the Public Land states also fall into the Sparsely Populated group of states.

Table 5 is a simple assessment of what the total capital outlay (state and federal) might be under two scenarios of federal matching shares: 50 and 80 percent (80 percent is selected to allow easy arithmetic).

Table 5. Total Capital Outlay Under Different Scenarios (Millions) in a Hypothetical Example

	Federal Share	
State Scenarios	50%	80%
Public Support	$ $\geq$10	$ $\geq$25
No Public Support	$\leq$32	$\leq$25

Consider first the scenario where the program carries public support. If the federal share is 50 percent, total capital outlay will be at least $10 million ($5 million state resources plus matching federal aid) and as great as $32 million if lapsing of federal funds is deemed undesirable. If the federal share is 80 percent, total capital outlay will be at least $25 million ($5 million state resources plus $20 million matching federal aid).

If the program does not carry public support, then the total capital outlay will be no more than $32 million under a 50 percent federal share (minimum sum necessary to prevent lapsing of $16 million federal aid) and may be considerably less if lapsing is tolerated. When the federal share is 80 percent, the maximum limit on total capital outlay becomes $25 million.

It is interesting to carry this analysis further and assume two scenarios of public support: willingness of public to make additional state resources available in the amounts of (1) $15 million and (2) $20 million. Further, let the absence of public support be characterized in two ways: (1) no additional resources made available and lapsing of federal aid permitted to occur; (2) additional resources made available in an amount sufficient to prevent lapsing of federal aid. The assessment of what the total capital outlay on the secondary program might be under these assumptions is shown in Table 6.

Table 6. Further Analysis of Total Capital Outlay in Hypothetical Example (Millions)

	Federal Share	
State Scenarios	50%	80%
Public Support		
$15 additional resources	$40	$44
$20 additional resources	49	49
No Public Support		
Permit lapsing	10	25
Do not permit lapsing	32	25

If $15 million additional resources are made available so that a state's own resources become $20 million, then the total capital outlay would be $40 million with 50 percent federal share ($20 million each from state and federal sources) and $44 million with 80 percent federal share ($24 million federal aid plus $6 million matching state funds plus $14 million additional state funds). If $20 million additional resources are made available so that state-own resources become $25 million, then the total capital outlay would be $49 million with both 50 percent federal share ($24 million federal aid plus $24 million matching state funds plus $1 million additional state funds) and 80 percent federal share ($24 million federal aid plus $6 million matching state funds plus $19 million additional state funds).

If there is no support for additional highway taxes (or for use of bonds) even at the risk of lapsing federal aid, the total capital outlay would be $10 million with 50 percent federal share ($5 million each from state and federal sources) and $25 million with 80 percent federal share ($5 million state funds plus $20 million matching federal aid). If sufficient resources are made available to prevent lapsing of federal aid, the total capital outlay becomes $32 million with 50 percent federal share ($16 million each from state and federal funds) and $25 million with 80 percent federal share ($5 million state funds plus $20 million matching federal aid).

Although this hypothetical example is simplistic and the numbers regarding total capital outlay can come out differently depending upon the assumptions made regarding federal matching shares, amount of federal aid available and the portion which would lapse at the end of the year, etc., some basic relationships hold. When state-own resources are plentiful so that matching federal aid is not a problem, incremental changes in the federal matching share will have no effect (subject to qualifications described below). That is, the total capital outlay will remain the same. Thus, in Table 6, when the state has $25 million available for the secondary program and when the amount of federal aid available is $24 million, changing the federal matching share from 50 percent to 80 percent or vice versa has no effect. This type of a situation (federal matching share becoming irrelevant over a certain range) occurs when (a) state-own resources are so plentiful that matching federal aid is not a problem; and (b) the state objective is to maximize highway program activity.[1]

However, states may wish to reduce highway expenditure from own resources because of the availability of federal aid. In this situation, it is worth noting that very high federal matching shares create greater opportunity for

[1] For further discussion of these issues see the companion paper by Rees, L. P. on "Highway Matching Requirements and Funding Levels: A Model of State Response" (Appendix B).

reducing state expenditure from own resources than lower matching shares. Using the hypothetical example, when state-own resources are $25 million, $24 million of these (96 percent) are required to match federal aid when the federal share is 50 percent, and $6 million (24 percent) is required to match federal aid when the federal share is 80 percent. Obviously, the federal matching share is critical here in determining the extent of substitution which takes place.

When state-own resources are not so plentiful and matching federal aid becomes a potential problem, the matching share becomes a critical factor in state allocative decisions. Looking at Table 6, when the state own resources are initially $5 million and lapsing of federal aid is not tolerable, $11 million additional state resources must be found when the federal matching share is 50 percent while no additional state resources need to be found (to prevent lapsing) if the federal matching share is 80 percent. If the secondary program activity has sufficiently high priority and/or lapsing federal aid is sufficiently unattractive, the lower federal matching share (in this example 50 percent) has the effect of making total capital outlay higher (by inducing additional state resources) than under the higher federal matching share. There is opportunity for gamesmanship here between attempting to induce increased program activity by low federal matching shares on the one hand and attempting to increase the federal matching share in order to relieve pressure on state finances.

Extrapolating this result to the proposed expansion of the federal aid program for bridge replacement and improvement, one could argue that if bridge deficiencies are truly critical and extensive, then in order to induce a massive corrective program, the federal aid should be large but involve medium federal matching shares. On the one hand, a high federal matching share might be in order if it is believed that significant incentives are required to induce state participation or if equity is a primary issue (not place a state in an unduly burdensome financial situation in terms of difficulty in matching federal aid).

It would appear that the extent to which a federal aid program matches with the perceived highway needs of a state may well be the most critical factor in state allocative decisions. The Interstate program stimulated all states in the 1960s but its stimulative effect fades in the 1970s for all except the Southern states (including such "sun-belt" states as Arizona and Texas). The latter have, of course, been experiencing significant increases in population, economic activity, and presumably therefore highway needs in recent years. The ABCD highway projects are the bread-and-butter variety, especially for the Industrial states and this is reflected in the results. The ABCD federal aid coefficients for the Industrial and Sparsely Populated states are all highly significant and the profile of the coefficients between these two groups is in marked contrast.

C. Noncapital Regressions

Selected findings from the administrative expenditure (ADMINX) and state highway user revenue (USERREV) regressions are shown in Figure 5. Only the coefficients of the federal aid term (AVTGP) in the administrative expenditure regressions and of the state own resources for capital outlay (SOCONSTX) in the user revenue regressions are shown in the figure.

The profile of the AVTGP coefficients in the ADMINX regressions shows that federal aid has seemingly increased state administrative and policing expenditures and that the amount of the increase has itself increased over time. In the 1957-61 time period, one dollar of federal aid related to additional administrative and policing expenditures of about four cents; in the

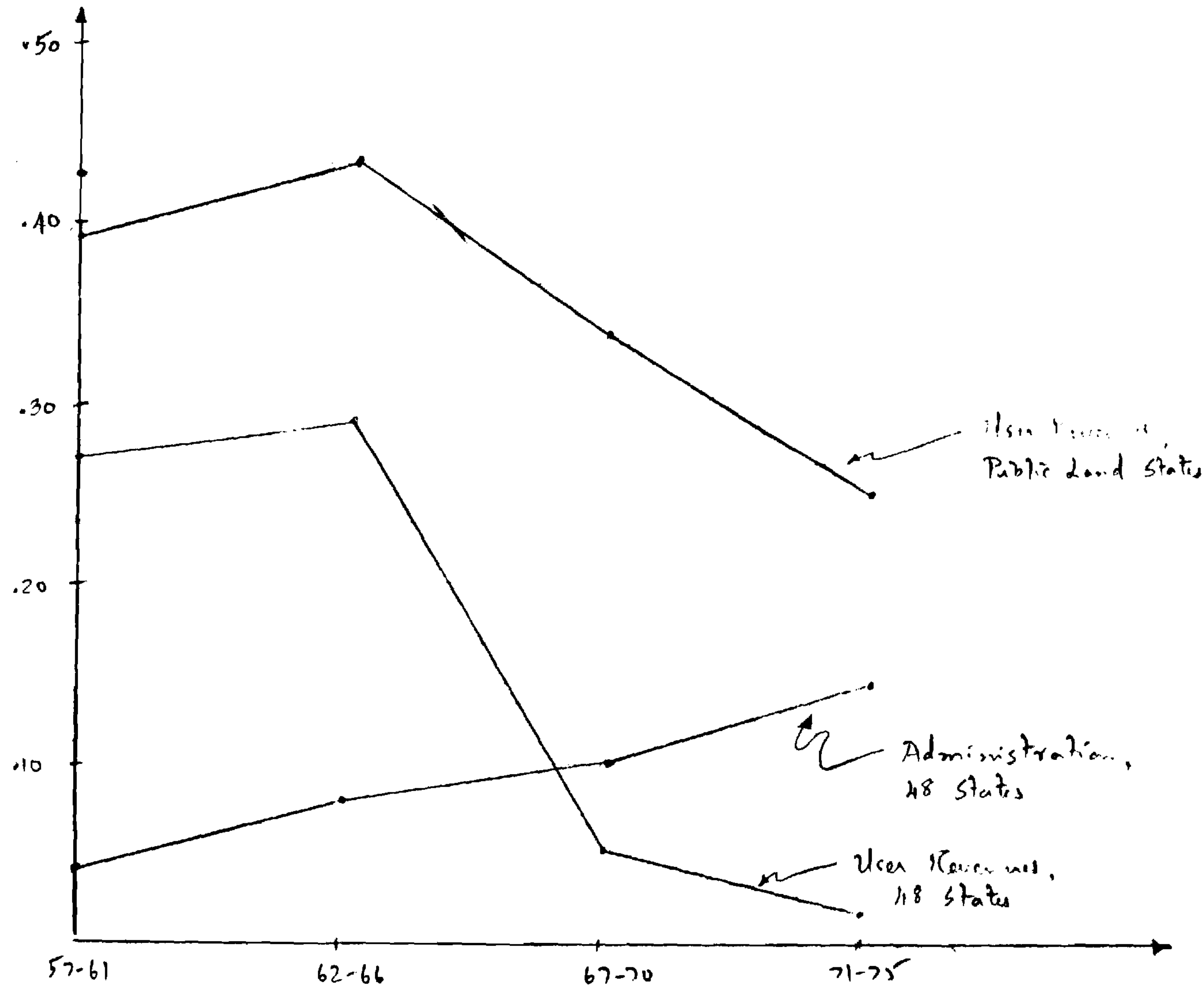

Figure 5. Coefficients of AVTGP in Administration Expenditure Regressions and of SOCONSTX in User Revenues Regressions

1971-75 period, this increase had risen to about 14 cents. (These results are in constant dollars as are all results in this paper.)

The profile of the SOCONSTX coefficients in the USERREV regressions shows that the increase in user revenues (and thus highway user taxes) associated with increased state-own expenditures for capital outlay has decreased over time. This might be attributed to increased use of toll road and bond financing. This practice is also more prevalent in the Industrial states (particularly eastern states) and less so in the western and midwestern states which largely make up the Public Land and Sparsely Populated categories.[1]

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[1]One might have thought that the decrease in the coefficient of SOCONSTX might also be due to a substitution over time of federal aid projects for 100 percent state financed projects. However, this explanation is not supported by the data. The proportion of total capital outlay devoted to road projects ineligible for federal aid is higher in the 1970s than in the 1960s.

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX D

THE APPALACHIAN DEVELOPMENT HIGHWAY SYSTEM

by

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16. Abstract
This study concerns the effects of Federal transportation funding policies, as reflected in the Appalachian Development Highway System (ADHS). The ADHS, as the major component of the thirteen-state Appalachian Regional Commission's transportation program, is particularly significant in several regards. It is a large venture - $3 billion in Federal and State funds have already been obligated. And, considerable work remains to be done, as only some 1300 of the authorized 2900 miles requiring construction are improved to standards and open to traffic. This work is part of a broader study that addresses the effects of funding structures across highway, airport and transit modes.

The report is structured with each of the discrete analyses available separately as follows:

Appendix A, Mass Transit
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

17. Key Words

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Table of Contents

page

Summary iii

I. Introduction 1

II. Background 3

A. The Appalachian Regional Commission and Its Highway Program . 3

B. Analytical Considerations 7

C. State Comparisons 12

D. Analytical Methods 14

III. The Effects of the Appalachian Development Highway System 15

A. Stimulation of State Highway Construction 16

B. Relationship Between the ADHS and Other Highway Programs . . . 25

1. Interstate 25

2. ABC 26

3. Non-Federal-Aid Roads 29

C. Socio-Economic Impacts of the ADHS 30

D. Comparison of the ADHS and Interstate Programs 32

IV. Implications of the ADHS Funding Parameters 33

A. Differential Matching Ratios 33

1. 2-lane vs. 4-lane 33

2. Non-use of the Bonus Match 34

3. Changing ADHS and ABC Ratios 37

B. Time Constraints on the Availability of Federal Funds 40

V. Some Observations 42

Summary

The Appalachian Development Highway System (ADHS) involves a multi-billion dollar categorical aid program established in 1965. It is intended to further mobility and economic development in the thirteen state Appalachian Region, and it is contributing toward those aims according to the Appalachian Regional Commission.

The ADHS is of special analytical interest because it represents a substantial Federal transportation aid venture, but one that is limited to selected states. Because of this restriction, it is possible to compare the effects of Federal aid policies between the ADHS and other highway programs, and between the involved Appalachian states and other states not participating in the program. To establish sharp contrasts, we formulate a group of five core ADHS states most affected by the program and a comparison group of nine states similar in highway and socio-economic character, but without ADHS activity.

Results of comparisons between these groups of states on time series of highway expenditures are interesting in several regards. The ADHS, a program of Federal aid and also of strong state commitments, is associated with the stimulation of overall state highway effort. In particular, it is notable that state funds were raised, at least in part to meet ADHS needs, by substantial increases in bonded indebtedness and gas tax rate increases.

While the ADHS appears to have stimulated increased state highway investments, the amount of that increase is somewhat less than the amount invested in the ADHS. Hence, it is useful to see what has happened to capital investment in other highway programs during the period of ADHS development. The Interstate system has suffered no significant decrement in investments because it is supported to the tune of 90% by Federal aid. While there are analytical difficulties in separating Federal-aid Primary (A), Secondary (B), and Urban Extensions (C) data, results are strongly suggestive. Excluding the ADHS investments (which are tallied with the A system), total (state, including Federal aid) investments have been somewhat constricted on the B and A systems relative to non-ADHS states. This is not the case with either the C or non-Federal-aid road programs, wherein the core ADHS states have outspent the comparison group. On the whole, the ADHS program has been undertaken without serious reductions in other highway efforts despite some dampening in specific program areas.

In analytical terms, an interesting question is raised concerning the interpretation of regression findings. Regressions on state highway expenditures have focused on the implications of the Federal aid terms. These have been studied to decide to what extent Federal funding has stimulated state effort. Observation of time series data on the ABC system usefully augments the regression analyses. In particular, the time series show a distinctive period in which constant dollar (i.e., corrected for inflation) Federal aid for ABC highways decreased while state expenditures increased. This suggests two plausible explanations for a negative coefficient observed between Federal ABC aid and state expenditures. For one, states may have invested more to make up for the reduced Federal funds for ABC programs the

states perceived as needing higher levels of investment (i.e., "reverse substitution"). Alternatively, one might surmise that the observed negative coefficient reflects the complex interworkings of a number of influences not well-accounted for in the regression formulations.

Turning back to the ADHS, it has progressed well in comparison with the Interstate program - despite a lower Federal aid share and less-forceful funding demands on the states. The ADHS, in conjunction with Interstate highways in the Region, appears to be contributing to its objectives of reducing isolation and fostering industrial development.

The ADHS seems to be highly compatible with state priorities. These state priorities surface in several cases. For one, some states indicated a willingness to forego a more favorable Federal matching share unless it were linked with increased funding levels so that total ADHS construction effort would not be cut back. Furthermore, states largely decided to build 4-lane ADHS instead of 2-lane, despite a 50% versus 70% Federal matching share. Other responses to funding provisions, such as not taking advantage of a "bonus" match possible by combined ADHS and ABC funding on a segment, indicate that the ABC program acts like a block grant, subsidizing states but not exerting substantial leverage on their investment patterns. When state resource availability is very limited, programs are likely to behave more "categorically," i.e., exerting leverage on state priorities.

All-in-all, the analysis supports the viability of categorical Federal aid programs such as the ADHS, particularly where they coincide with perceived state priorities.

I. Introduction

This study concerns the effects of Federal transportation funding policies, as reflected in the Appalachian Development Highway System (ADHS).[1] The ADHS, as the major component of the thirteen-state Appalachian Regional Commission's (ARC) transportation program, is particularly significant in several regards. It is a large venture - $3 billion in Federal and state funds have already been obligated. And, considerable work remains to be done, as only some 1300 of the authorized 2900 miles requiring construction are improved to standards and open to traffic.[2] Appalachian highways are becoming a timely topic as consideration of a special coal-haul roads program continues. Furthermore, the ARC and other regional commissions are presently under review.

One might surmise that the best way to understand the implications of Federal funding structures would be through study of national programs. Quite to the contrary, analysis of regional programs such as the ADHS is potentially more informative. One must somehow sort out the effects due to Federal policies from those attributable to confounding forces such as environmental initiatives, energy crises, and impoundment practices. The ADHS is especially interesting in that only some states were involved, thereby offering a basis for comparison with other states who, to a substantial degree, were subject to similar external forces.

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[1]This report is based upon the analytical work performed in the Master's thesis of C. Y. Park entitled, "Analysis of the Appalachian Development Highway System as a Policy Intervention," Georgia Institute of Technology, Atlanta, 1978. It is part of a broader study for the Office of the Secretary, U.S. Department of Transportation that addresses the effects of funding structures in highways, airports, and public transit (Contract DOT-05-70036; P. J. Barbato, monitor). We deeply appreciate the insights offered on current and future policy issues by the many knowledgeable transportation professionals acknowledged in our overview report.

[2]Federal Highway Administration, News Release, Washington, D.C. FHWA 15-77, March 21, 1977.

The special funding provisions for the ARC states provide an opportunity for analysis of the effects of changing Federal transportation funding structures. This study focuses on the ADHS to raise a series of questions concerning the effects of a special categorical program:

1) Did the ADHS stimulate total state highway investments?
2) Did states reduce their level of effort on other highways to meet the demands of this new program? If so, which other programs were affected?
3) What have been the direct and secondary effects of the ADHS? Is it fulfilling its objectives of providing mobility and spurring economic development?
4) How does the ADHS program compare with the Interstate (I) Highway program?
5) What have been the effects of differences in Federal matching share within the ADHS (two-lane and four-lane road differences) and between the ADHS and the Federal-aid Primary (A), Secondary (B), and Urban (C and D) programs?
6) What have been the results of the levels of assurance of ADHS funding and lapse of aid conditions on program effort?

The following section provides the necessary background for consideration of these questions. The third section deals with the effects of the categorical ADHS program (Questions 1-4), while the fourth addresses the implications of particular funding parameters (Questions 5-6). It should be noted that the emphasis is on understanding the implications of particular Federal funding strategies, not upon evaluation of the ARC's highway program (hence, question 3 is of secondary concern).

II. Background

A. The Appalachian Regional Commission and Its Highway Program

By the early 1960's, Appalachia was seriously lagging behind the rest of the country in several regards. While heavily populated (18,000,000 in 195,000 square miles in 1965), the population growth rate was a low 1%, compared to the U.S. average of 5%, for 1965-70.[1] Of most concern, was its poor economic status. Per capita income in central Appalachia was only 52% of the U.S. average in 1965, (78% for Appalachia as a whole).[2] In response, the Appalachian governors proposed an effort to attack the critical social and economic problems. President John F. Kennedy appointed a President's Appalachian Regional Commission in 1963 to formulate a program. Acting on that Commission's recommendations, Congress adopted the Appalachian Regional Development Act of 1965.

The Appalachian Regional Development Act set up the Appalachian Regional Commission (ARC) and authorized a range of social, as well as transportation, programs. The Act established the ARC to consist of a Federal co-chairman and the governor (or his representative) from eleven states: Alabama, Georgia, Kentucky, Maryland, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia. The Act permitted inclusion of certain New York counties, a step soon taken by the Commission. Amendments to the Act in 1967 added Mississippi counties. Thus, the 195,000 square mile Appalachian region consists of all of West Virginia and portions of twelve other states (Figure 1).

A major feature of the Act was its highway program. Isolation was

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[1] The Appalachian Regional Commission, 1975 Annual Report, Washington, D.C., 1975, p. 12.

[2] Ibid., p. 23.

ROADWAY SYSTEM

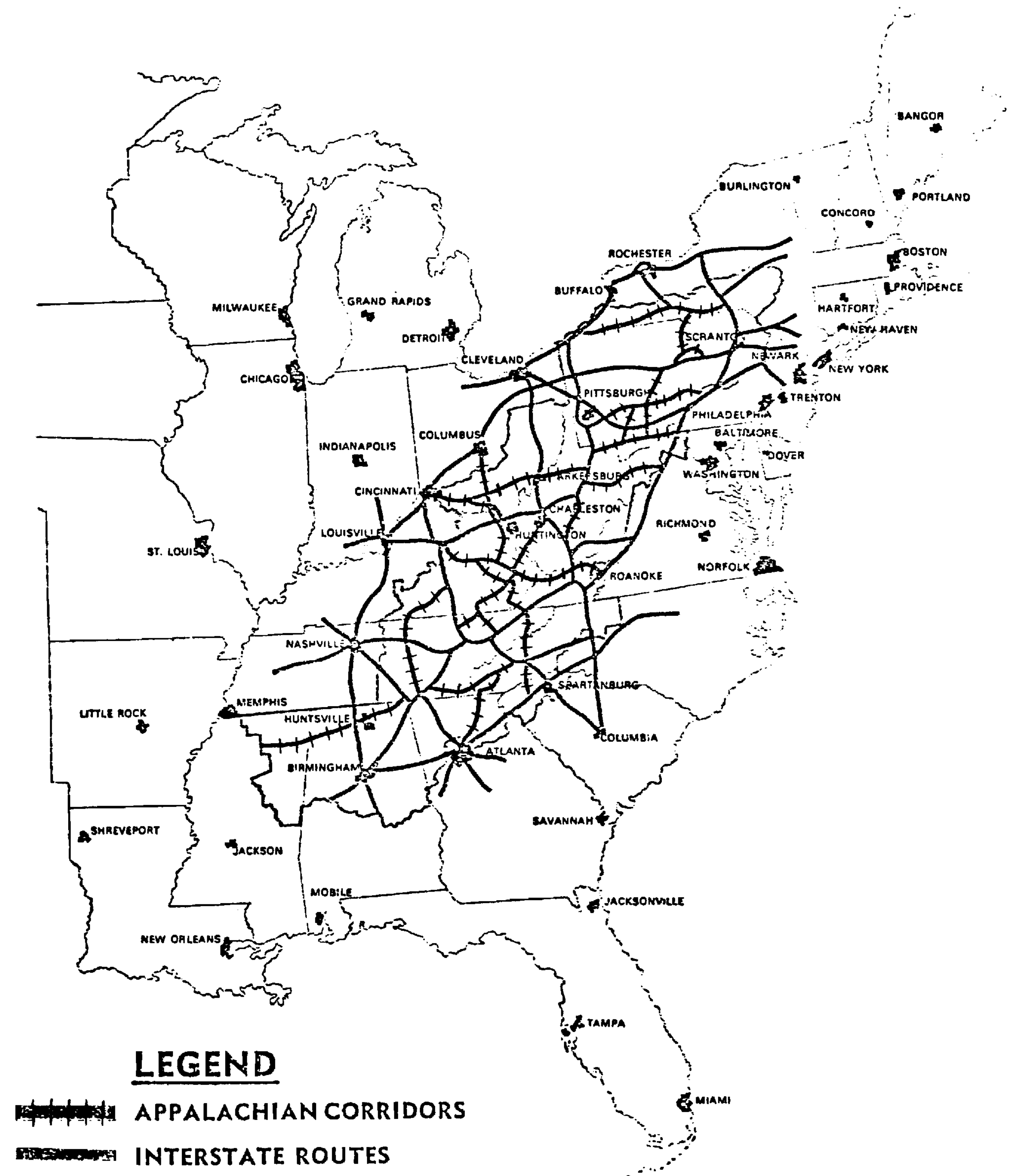

Figure 1. Appalachian Development Highway System. (From Appalachian Regional Commission, The Appalachian Highway Program: Progress, Impacts, and Planning for the Future, Washington, D.C., December, 1975, p. 26.)

identified as a major factor contributing to Appalachia's relative economic stagnation. This isolation resulted primarily from the difficulties of transport in a rugged region. Narrow, winding roads followed the terrain, increasing travel distance and time. This, in turn, inhibited potential industrial developers because of the problems in getting products to market. Poor roads also made it difficult for Appalachians to reach jobs, schools, and health facilities. Yet better roads were prohibitively expensive - double and often triple the average, national, per-mile construction costs.[1] Even the few Interstate routes that crossed the region tended to follow the topography, not crossing from east to west over the mountain ridges.

> In response to these conditions, Congress authorized construction of the Appalachian Development Highway system as a framework to connect the major federal highway arteries and to give areas of dense population ignored by Interstate routes better access to jobs and services.
>
> The Act further authorized..."access road(s) that will serve specific recreational, residential, commercial, industrial, or other like facilities..."[2]

The ARC transportation program consisted of the ADHS, the access roads, and supplemental grants to enable local participation in other Federal aid programs (e.g., airport construction and improvement). These transportation endeavors take place in the context of the total ARC program. For instance, through September, 1976, highway project costs amounted to $2.9 billion ($1.7 billion Federal aid) while eligible non-highway project costs were $3.7 billion ($2.1 billion Federal).[3]

We chose to focus on the ADHS separately from the other programs. Of

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[1] Ibid., p. 6.

[2] Ibid., p. 29.

[3] Appalachian Regional Commission, 1976 Annual Report, Washington, D.C., 1976, p. 33.

most concern in this regard was leaving out the access road program. However, as of December, 1976, 95% of the Federal funds obligated for Appalachian highways went to the ADHS.[1]

The ADHS can be characterized as a categorical program with a designated system of roads and a mileage ceiling (currently, 2900 miles for construction assistance). In these respects it is similar to the Interstate program. However, its 24 designated corridors are restricted to the Appalachian region (Figure 1), and the program is supported by general fund revenues, not the highway trust fund. All of the states had to agree to the funding priorities involved.[2] The ADHS program is administered by the Federal Highway Administration (FHWA) for the ARC. It utilizes the traditional partnership arrangement between FHWA and the state highway departments under which nearly all Federal-aid highway programs are carried out.

The objectives of the ADHS, broadly speaking, are to increase mobility and, thereby, foster economic development. Some of the operational objectives that have been advanced are:[3]

- to fill in gaps in the Interstate system (generally following a Federal-aid Primary Route) so as to maximize the percentage of the population within 30 minutes (20 miles) of an ADHS or I highway;
- design to the extent practicable to standards adequate for 1990 traffic (now for 20 years);

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[1]Federal Highway Administration, op. cit., p. 1.

[2]For priorities, see Appalachian Regional Commission, The Appalachian Highway Program: Progress, Impacts, and Planning the Future, Washington, D.C., December, 1975.

[3]Appalachian Regional Commission, Highway Policy Issues Report, Washington, D.C., June, 1974, p. 27-28.

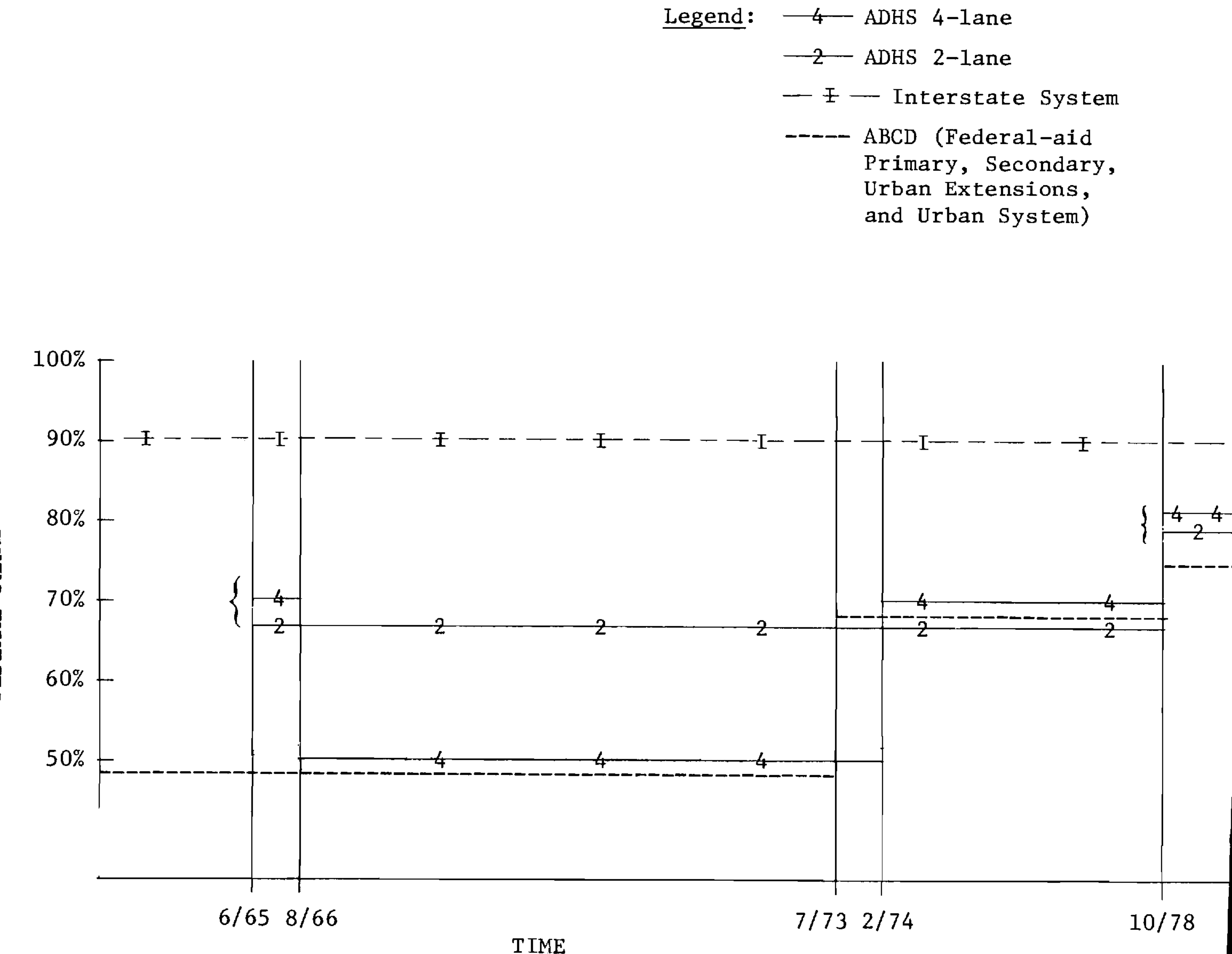
- design and construction to achieve continuity and reasonable uniformity throughout the system, and to provide for an average travel speed of approximately 50 miles per hour between major termini;
- provision for partial or full control of access, where justified.

Given our interest in Federal funding parameters, a critical dimension of the ADHS program is the relative Federal and state contribution. Figure 2 profiles the matching ratios for the ADHS over time. Two ways of considering these will be used. First, the ADHS can be thought of as competing for scarce state resources with all other governmental programs, but particularly with other highway programs. In this light, the Interstate provides "10¢" dollars (each 90¢ of Federal aid required 10¢ state match). Through fiscal year (FY) 1973, the "ABCD" program used a 50:50 matching ratio, since then, 70:30, Federal to state. (This change is the stimulus for the increase in ADHS Federal share to 70%.)[1] Lastly, there are the state-administered roads not eligible for Federal aid. The second consideration about matching ratios is internal to the ADHS. Note that from August, 1966 through February, 1974, construction of 4-lane roadway received only a 50% contribution, whereas 2-lane construction was eligible for 70% Federal share. These differences in matching ratio - both between the ADHS and other highway programs, and within the ADHS - provide a chance to analyze the importance of higher Federal shares.

B. Analytical Considerations

Our intent is to analyze the implications of the ADHS as a special categorical program, with particular funding structures (e.g., matching ratios). Before undertaking that analysis, it is important to take

[1] The 1978 Surface Transportation Act increased the Federal share on ABCD roads to 75% and permitted increase on ADHS highways to 80% (approved by the ARC).



Note: For 4-lane ADHS roads, acquisition of right-of-way and preliminary engineering could receive 70% Federal aid, even while construction was limited to 50%.

Figure 2. ADHS Federal/State Matching Requirements

a look at the complicating factors that must be taken into account.[1]

The first group of factors are those that affect all the states, more or less. These include:

- the drain on state resources, attendant to the major Interstate effort, especially in the 1960's;
- the shifting political demands toward environmental preservation, urban transportation alternatives, etc., especially in the 1970's;
- state highway budgetary constraints, peaking after the 1973 oil embargo;
- socio-economic factors and their rates of change - population, income, and unemployment.

We deal with these primarily through observation of trends over time for both a group of ARC states and a comparison group. Where inflation is a concern, we deflate expenditures using national highway construction cost factors (this does not guard against relative shifts in costs between ARC and other states).

Other threats to clear interpretation of ADHS effects bear chiefly on the ARC states. ARC programs other than the ADHS could affect the availability of state funds (more Federal aid, but more programs placing demands). Access road efforts could contribute to state highway expenditures and mobility gains. ARC programs could well encourage economic development. Furthermore, the ARC programs do not meet a homogeneous group of states. In particular, New York, Pennsylvania, and Ohio are heavily industrialized, northern states. The Appalachian region extends into

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[1]A more detailed consideration of the confounding factors, the selection of a comparison group, and the statistical methodology appears in Park, C. Y., op. cit.

thirteen states, but while it includes all of West Virginia, it represents only 5.3% of Maryland's population and 15.6% of its land area, for example.[1] ARC expenditures reflect varying proportions of the state budgets. For instance, average ARC expenditures per year for 1965-70 as a proportion of total 1969 state expenditures amount to 4.9% for West Virginia versus 0.5% for Maryland.[2]

Because of such differences as those just mentioned, we must be cautious in interpreting effects, such as on state highway expenditures, realizing that the ADHS exerts only limited effects. To take into account the great variability among ARC states, we focus on a "core group," as described in Section II.C.

Another important dimension is time. Figure 2 presents a profile of ADHS matching requirements over time. For many purposes, we stop our analyses at FY1973 because of the changes that follow in Federal-aid provisions, though our data run through 1975. An even more difficult matter is the start of the ADHS. On the one hand, the states had the highway program plan from the 1963 President's Appalachian Regional Commission to use in preparing to get underway, and then the ARC provided for "quick start" construction projects. The Commission approved 87 miles of these and construction began in June, 1965.[3] On the other hand, the overall start was not so quick. Despite an initial appropriation of $200 million through FY1966 for the highway program (including access roads), only $104

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[1] Appalachian Regional Commission, The Appalachian Experiment 1965-1970, Washington, D.C., 1972, p. 88.

[2] Ibid., p. 88.

[3] ARC, The Appalachian Highway Program: Progress, Impacts and Planning for the Future, Washington, D.C., December, 1975, p. 7.

million was obligated.[1] In FY1967, \$68 million more was obligated, followed by about \$140 million per year for the next two years, gradually increasing thereafter. Actual expenditures lag considerably:[2]

FY1966	\$ 9 million
FY1967	40 million
FY1968	65 million
FY1969	113 million
FY1970	130 million

Time series analyses attempt to reflect this gradual start-up of ADHS activities.

Finally, we mention the difficulty in accounting of highway expenditures (outlays), specifically:

- Due to a change in FHWA reporting practices (in Highway Statistics)[3] there is a discontinuity in total state A and B system outlays from calendar 1973 to 1974.
- Any disaggregation among A, B, C, and D systems for state-only outlays (exclusive of Federal aid) is somewhat in error because total state outlays are reported on the basis of where funds were spent while the Federal aid is reported on the basis of the system for which the funds were designated. Transfers among the systems can be substantial, causing the accounting problem.
- Our data include toll road expenditures in total state outlays,

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[1] Legislation authorizes funding; a separate appropriations bill makes this available during a given FY. The ARC allocates these appropriations to the states (resulting in their entitlements). An obligational ceiling is the maximum amount of funds a state can commit in a FY. Obligated funds are those actually approved to be expended for specific work. Lastly, actual outlays or expenditures result to pay for that work. (Based on ARC, Highway Policy Issues Report, Washington, D.C., June, 1974, p. 11-12.

[2] These figures for the ADHS and access roads are from Brinley Lewis of the ARC.

[3] Federal Highway Administration, Highway Statistics, Washington, D.C., annually.

outlays on Interstate, and outlays on non-Federal-aid roads (all from Table SF-21 of Highway Statistics), but not on A, B, and C outlays (from Table SF-11).

- Our total (but not separate) A, B, C, and D outlay data are compatible before and after 1973; however, they include toll outlays to the order of 1%-3% of the total.
- Tallies for "state-only, exclusive of Federal aid" outlays are imperfect because Federal aid reflects reimbursement for work completed, and this could often be work reflected in state outlays for an earlier year.
- Based on advice of ARC and FHWA professionals, plus some statistical detective work, we concluded that ADHS outlays are included in Highway Statistics reporting for the A (primary) system. [After construction is complete, ADHS roads are placed on the primary system.]

C. State Comparisons[1]

Preliminary analyses on the thirteen ARC states indicated their heterogeneity, prompting us to seek a more homogeneous core group likely to most feel the impact of the ADHS program. First off, Alabama, Mississippi, and South Carolina were eliminated because none had received any Federal ADHS funds through FY1972, and they have negligible construction complete as of 1975. Secondly, New York, Ohio, and Pennsylvania were set apart because of their socio-economic characteristics (often taken as explanatory variables in accounting for state highway expenditures)[2]. These three are heavily

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[1]The selection procedure is detailed in Park, C. Y., *op. cit.*

[2]c.f., Dye, T. R., Politics, Economics and the Public, Rand McNally, Chicago, 1966.

industrialized and urbanized, quite in contrast to the other Appalachian states. Of the seven remaining ARC states, Georgia and Maryland have relatively small ADHS programs (85.7 and 81.9 participating miles, respectively, vs. 193.6 miles for the next smallest of the seven, Virginia).[1] Interviews further substantiate the case for the remaining five as having active ADHS programs. They represent central and southern portions of Appalachia. The five core ADHS states are:

Kentucky
North Carolina
Tennessee
Virginia
West Virginia

As mentioned previously, a major tactic to control for the variety of external factors influencing highway efforts is to compare different states. To the extent that they are affected by the same forces, this achieves our purpose. For instance, if a group of states with relatively similar highway programs, socio-economic characteristics, and geographical factors act differently than the core ADHS states during the late 1960's, it may be plausible that the ADHS accounts for the differences. Toward the goal of securing the most suitable group for comparison with the core states, we examined the remaining states.

Drawing upon previous studies indicating relationships of several factors to state highway behavior, we performed a detailed discriminant analysis to identify a comparison group. Factors considered included:

- area;
- urban population;

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[1] Federal Highway Administration, News Release, Washington, D.C., FHWA 15-77, March 21, 1977.

- state-only capital expenditure (excluding Federal-aid) in relation to total state and Federal capital expenditure;
- state capital expenditure for non-Federal-aid systems as a percentage of total highway capital expenditures;
- a composite socio-economic and political behavior factor identified as "Southern."[1]

Using several statistical procedures, we identified nine states most similar to the core ADHS states (ruling out Georgia and Maryland because they had some ADHS activity) - the comparison group:

Alabama
Arkansas
Florida
Iowa
Louisiana
Mississippi
New Mexico
Oklahoma
South Carolina

Naturally, this group represents compromise on any one factor to obtain the best match on the composite factors. In particular, note that three of the comparison states (Alabama, Mississippi, and South Carolina) are ARC states. This was carefully considered as desirable given their lack of ADHS activity over the period of analysis and their sharing in other ARC programs that we were not investigating. For some purposes, however, we have eliminated these three states to provide a non-ARC comparison.

D. Analytical Methods[2]

Four analytical approaches went into producing the study results. The most basic is the presentation of straightforward descriptive statistics.

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[1]Luttbeg, N. R., "Classifying the American States: An Empirical Attempt to Identify Internal Variations," Midwestern Journal of Political Science, 15, 1971. The Luttbeg scale draws on 118 variables with values for 1961-1963. The other data were 1961 values; 1970 data yield similar conclusions.

[2]Discussed in detail in Park, C. Y., op. cit.

These usually involve a comparison between the core ADHS and comparison states over time. Second is the consideration of these time series in a more rigorous fashion. Going under the label "interrupted time series analysis," this provides relatively strong inferences as to the relationship between a policy implementation (e.g., creation of the ADHS, or a changed matching ratio) and observed measures (e.g., state expenditures on a given highway system).[1] The third complementary approach entailed multiple regression, following recent work by Sherman[2] and by Enns.[3] We have applied this in the context of categorizing states and time periods, then comparing key coefficients across the categories to see if significant changes took place. Lastly, the statistical findings were weighed against and interfaced with the insights gained in interviews with professionals in the ARC, FHWA, and state transportation agencies. The blending of these different sources of information is reflected in the following sections.

III. The Effects of the Appalachian Development Highway System

This section addresses a number of factors affected by the implementation of the ADHS. The main group of factors concern expenditure patterns - overall state expenditures and expenditures on particular highway programs.[4] The interest is to better understand the repercussions of the ADHS program

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[1]Glass, G. V., Willson, V. L., and Gottman, J. M., Design and Analysis of Time-Series Experiments, Colorado Associated Universities Press, Boulder, 1975.

[2]Sherman, L., The Impacts of the Federal Aid Highway Program on State and Local Highway Expenditures, Office of Transportation Planning Analysis, U.S. Department of Transportation, Washington, D.C., 1975.

[3]Enns, J. H., The Response of State Highway Expenditures and Revenues to Federal Grants-In-Aid, Rand Corp., Santa Monica, R-1233-FF, February, 1974.

[4]For present purposes, per capita analyses appear less appropriate. We are concerned with state investment decisions, drawing comparisons over time and between the two groups of states. Relative population levels of the two groups do not shift substantially over this period.

on other highway efforts. In particular, a detailed look is taken at the state ABCD program from several vantage points. Following this, the socio-economic impacts of the ADHS are briefly explored, and that program is contrasted with another categorical program - the Interstate Highway System.

A. Stimulation of State Highway Construction

We had anticipated that the Appalachian states, as represented by the five core ADHS states (Kentucky, North Carolina, Tennessee, Virginia, and West Virginia) would have used the newfound source of highway funds (the ADHS) to partially substitute for their own expenditures. Given the economic strains on the region, this would appear a likely response to the ADHS initiative. Not so, the five ADHS states appear to have increased, not only the total capital outlay (state and Federal funds), but also state only (exclusive of Federal aid) highway outlays. Figure 3 shows a widening gap between the ADHS states and the comparison group from essentially equal capital outlays on all roads (1955-1959) to about 65% greater outlay in 1972.[1] This is partly attributable to larger Interstate expenditures (Figure 4), but it also reflects higher outlay on the other Federal-aid roads (ABC Systems) (Table 1 and Figure 7) and on non-Federal-aid roads as well (Figure 10). Furthermore, contrary to our initial suspicions, maintenance efforts

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[1] Note the importance to contrast the patterns with a comparison group, given the real and inflationary increases in most of these series over time (c.f., Figures 3 and 4). [Figure 9 is shown in constant dollars to remove the highway construction inflation.] The rationale for inference as to the relationship between the inception of the ADHS program and observed changes in other series entails: 1) similarity of core ADHS and comparison states before the onset of the ADHS [FY66 for obligation data; about FY67/68 (calendar year 1967) for expenditure (i.e., outlay) data], 2) difference between the groups beginning soon after the change, and 3) absence of other logical explanations for the emergence of a difference. For several critical analyses, other comparisons were also made (e.g., with the five comparison states excluding New Mexico for lagging in ABCD expenditures and Alabama, Mississippi, and South Carolina for being in the ARC; or with all thirty-five continental states not in the ARC). Findings were consistent.

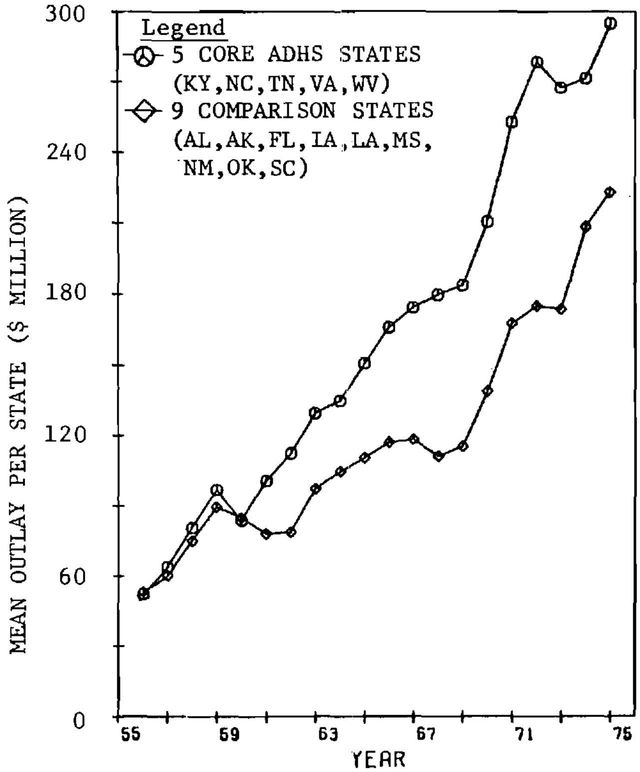

Figure 3. Total Capital Outlay for All Highways

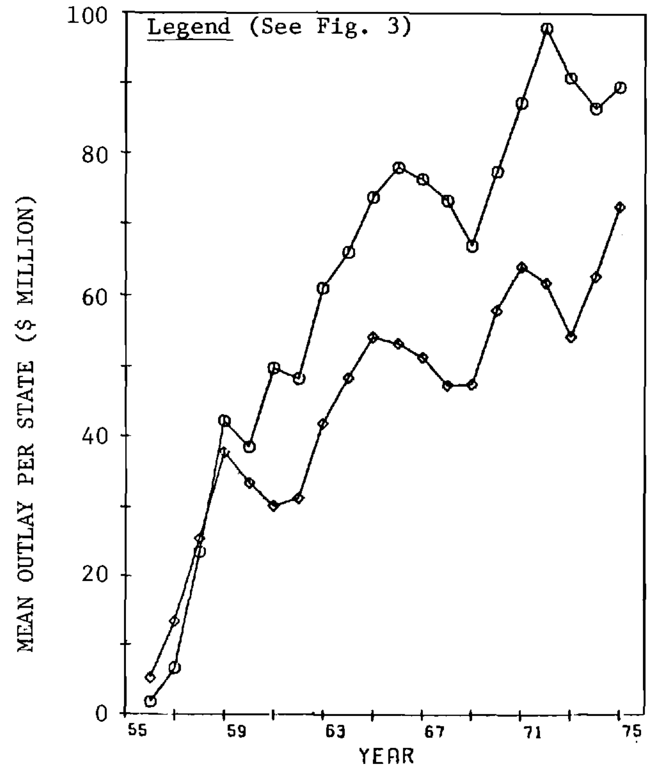

Figure 4. Total Capital Outlay for Interstate Highways

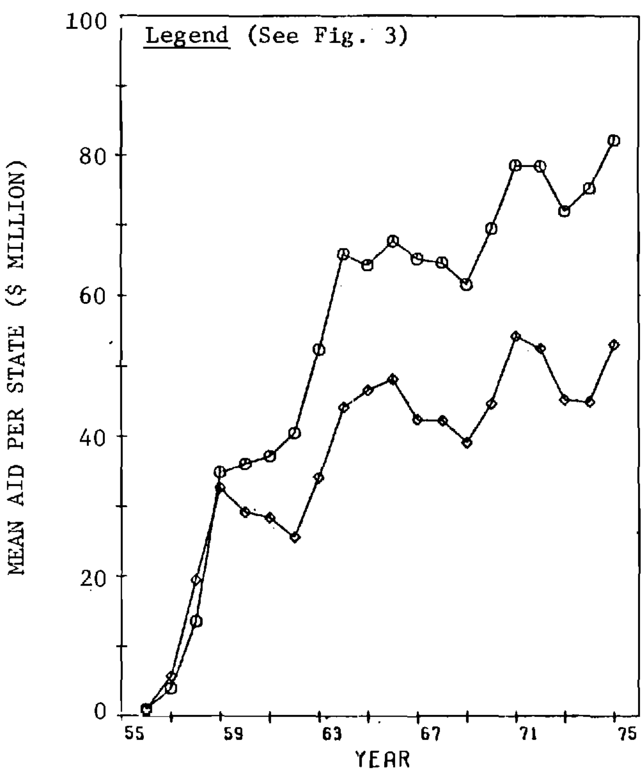

Figure 5. Federal Aid Expenditure for the Interstate System

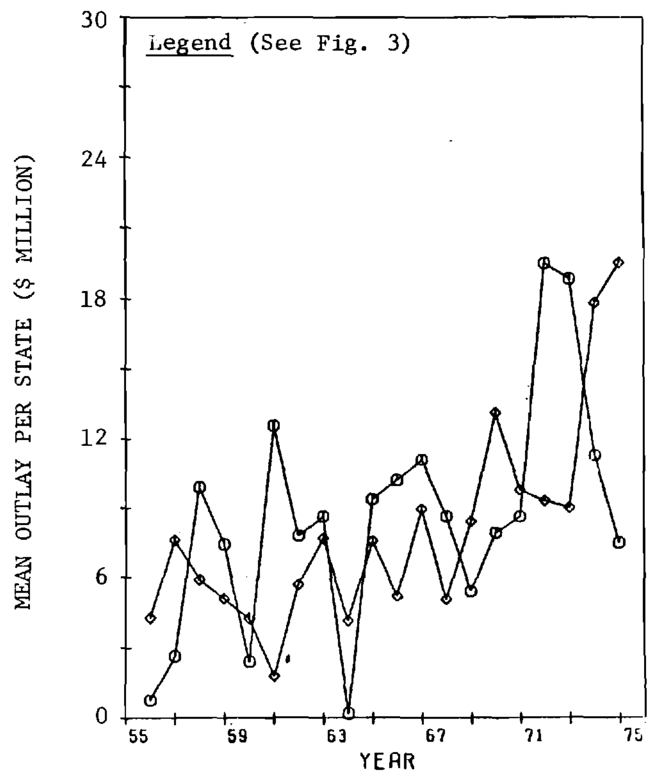

Figure 6. State Only (Exclusive of Federal Aid) Interstate Outlay

Table 1. State-only ABC Outlays
($ million)

	1963	1964	1965	1970	1971	1972
Experimental Group						
ABC and ADHS (1)	36.2	38.0	44.6	62.9	74.9	76.7
ABC only (2)[a]	36.2	38.0	44.6	51.4	63.4	62.6
Comparison Group (3)	31.2	31.5	31.2	53.3	65.3	64.8
Difference						
(1)-(3)	5.0	6.5	13.4	9.6	9.6	11.9
(2)-(3)	5.0	6.5	13.4	-1.9	-1.9	-2.4

[a] For 1970-72, estimated on the basis of a state share for the ADHS of 42.5% of total ADHS expenditures.

Source: U.S. Department of Transportation, Highway Statistics, Washington, D.C.

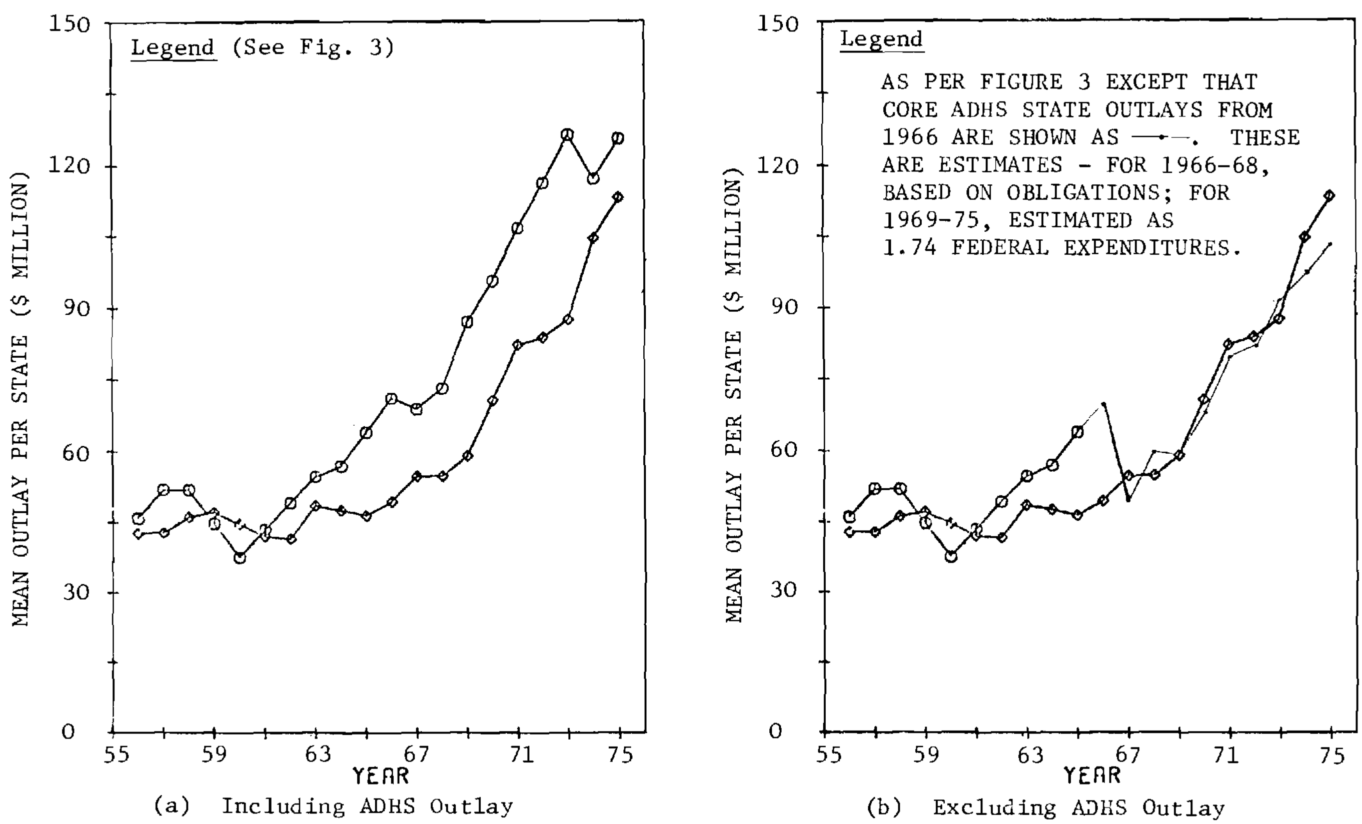

Figure 7. Total Capital Outlay for the ABC Systems

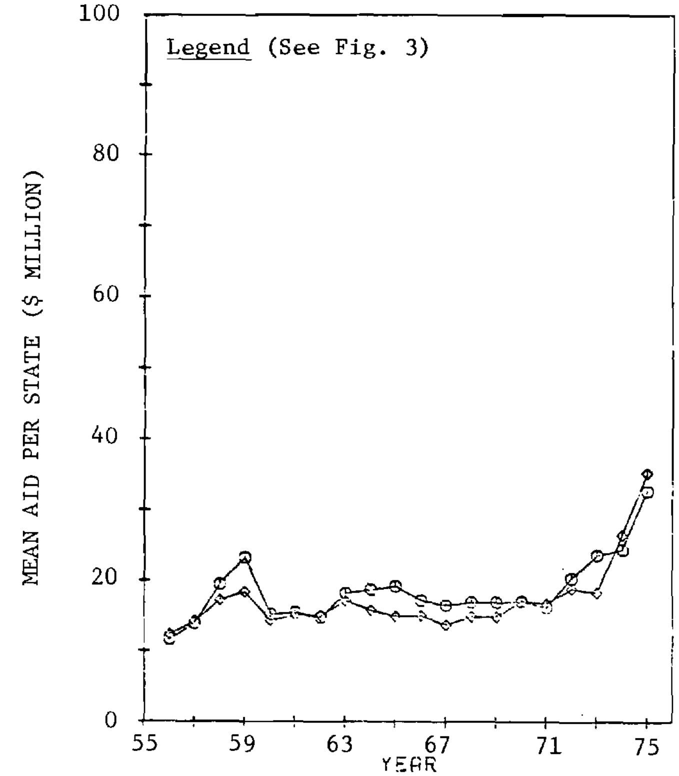

Figure 8. Federal Aid Expenditure for the ABC System, Excluding ADHS

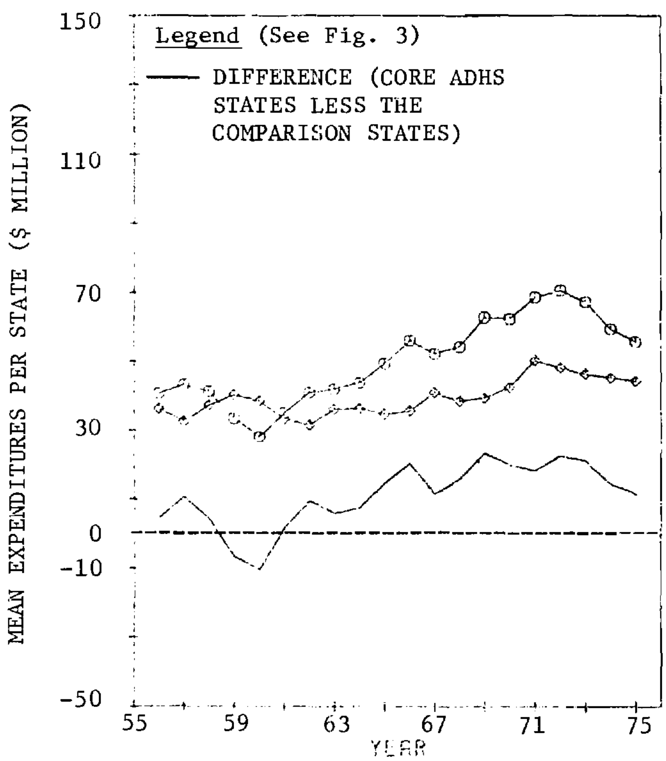

Figure 9. State Only (Exclusive of Federal ABCD Aid) Expenditures for the ABCD Systems in Constant 1967 Dollars, Including ADHS

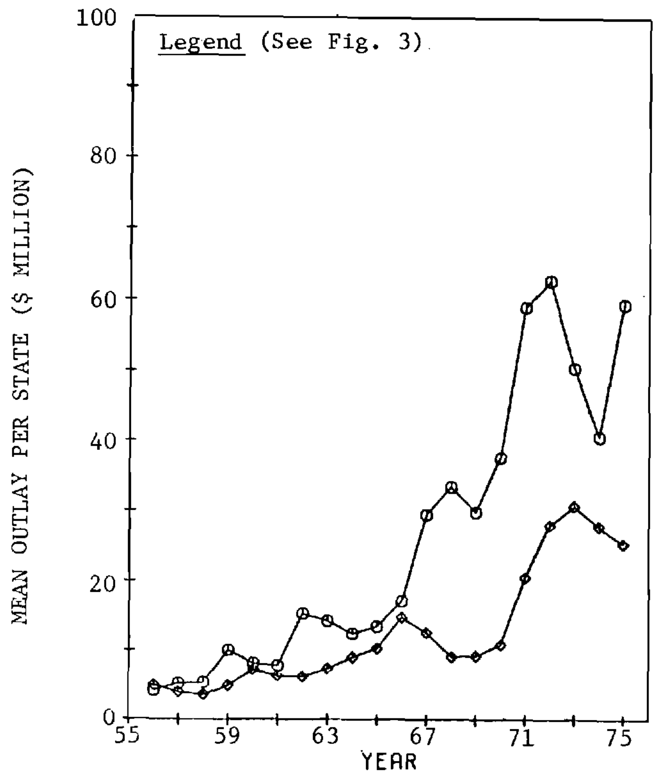

Figure 10. Capital Outlay for Non-Federal-Aid Highways

were not shortchanged. Figure 14 even suggests a considerable increase in maintenance expenditures for the core ADHS states relative to the comparison group.

One possible reason for the maintenance of state highway effort was the 1965 Appalachian Regional Development Act itself - Section 221 requires states to maintain expenditures at not less than the average of the previous two years. "Earmarking" of highway user revenues (i.e., legal restrictions on the uses to which they can be put) does not appear to be highly relevant to the ADHS outlay patterns. Although earmarking is a possible influence on state expenditure patterns,[1] the percentage of user revenues diverted from 1956-1970 by the five core ADHS states (mean = 3%, median < 1%) is very similar to that of the nine comparison states (mean = 7%, median < 1%).[2]

Recognizing an increased core ADHS state highway outlay, we wondered how it could have been supported. The answer appears to be from multiple sources. First, Federal highway aid increased to the amount of the ADHS program (average about $20 million annually in 1971) and the Interstate program (Figure 5), but not much for the ABC program until 1973 (Figure 8). Moreover, ADHS state general outlays for all purposes outpaced the comparison group (Figure 15 - note a substantial divergence in annual outlays), assisted by an increase in total Federal aid (Figure 16 - note here also that the annual outlays significantly diverge, presumably due in large measure to the ARC programs).

Perhaps, the most striking testimonial to the stimulation of the highway effort in the five core ADHS states is the increase in their bonded

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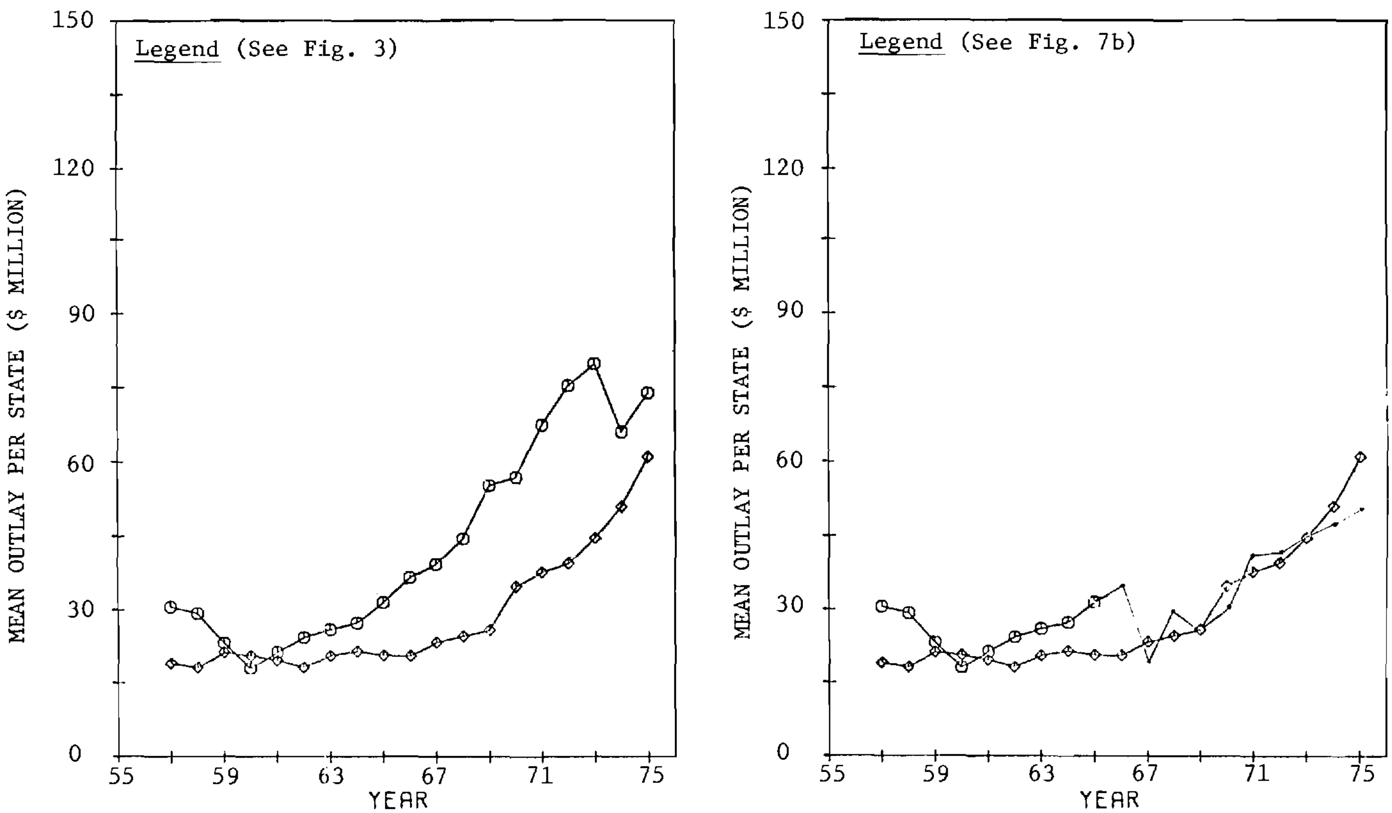
[1] Enns, J. H., "The Impact of Federal Grants-in-Aid on State Highway Expenditures and Revenues: An Econometric Study," Department of Economics, University of California at Los Angeles, 1973.

[2] Ibid., pp. 90-95.

indebtedness (Table 2) and gas tax rates (Table 3) relative to the comparison states.[1] The ADHS program is associated with a general boost in the state highway effort. (This does not demonstrate that the ADHS program was the only cause of this increase, but it obviously contributed. Recall that the ARC initiative involved the states in the first place, so it would be improper to assume the enhanced state highway effort was just a response to a Federal ADHS program.) Observations by ARC and FHWA personnel support the premise that the level of construction activity would decline in the absence of the ADHS program.[2]



(a) Including ADHS Outlay (b) Excluding ADHS Outlay

Figure 11. Total Capital Outlay for the Federal-Aid Primary (A) System

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[1] Inspection on a state-by-state basis indicates that the response is rather general, not peculiar to one or two of these five states.

[2] Appalachian Regional Commission, Highway Policy Issues Report, Washington, D.C., June 1974, p. 31; W. Aldridge, FHWA, personal observation.

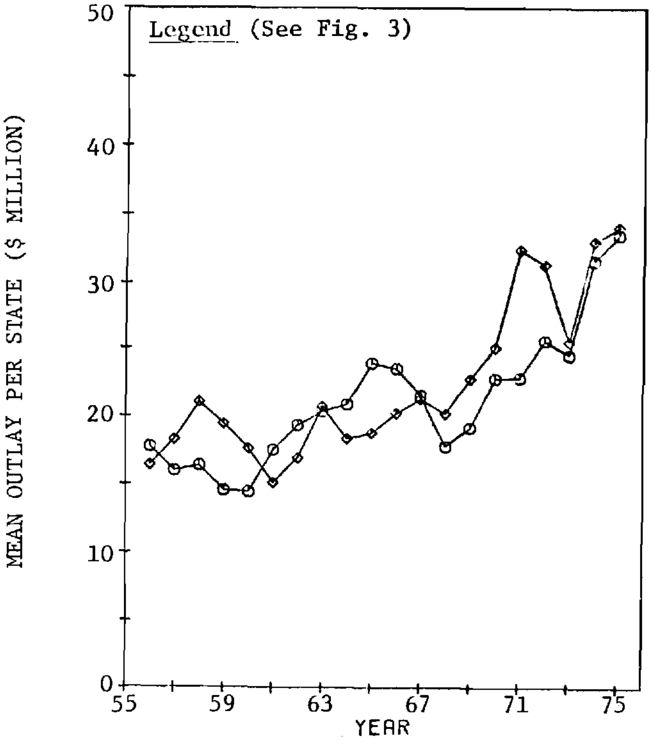

Figure 12. Total State (Inclusive of Federal Aid) Capital Outlay for the Federal Aid Secondary System (B)

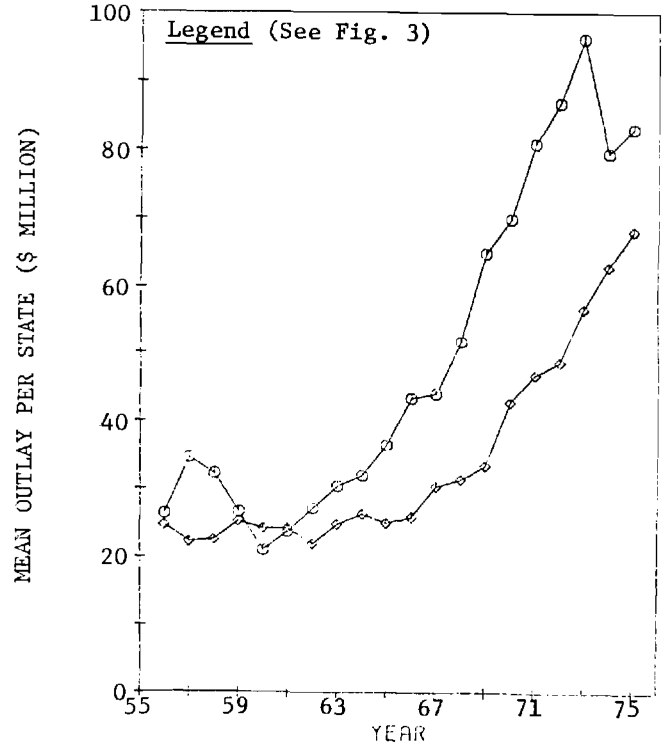

Figure 13. Total State (Inclusive of Federal Aid) Capital Outlay for the Urban Extensions of the Primary System (C)

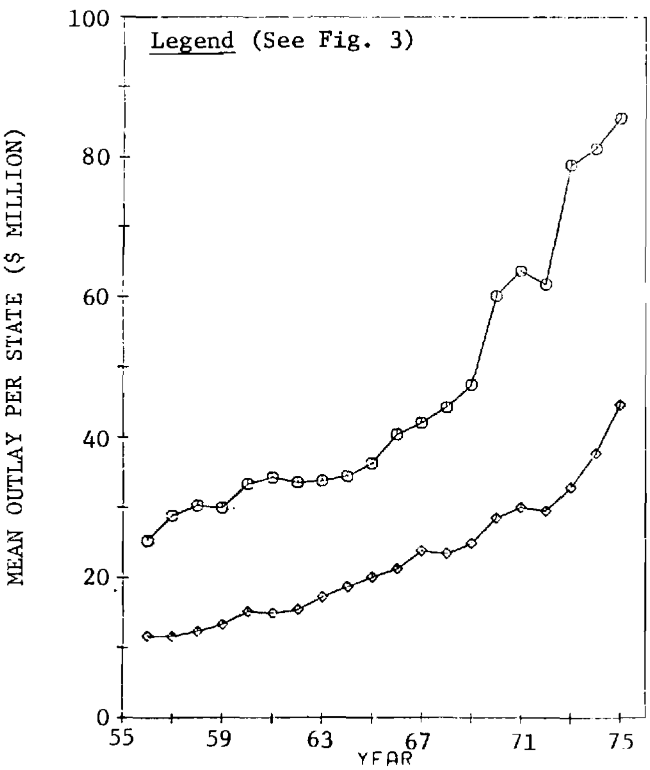

Figure 14. State Highway Maintenance Expenditures

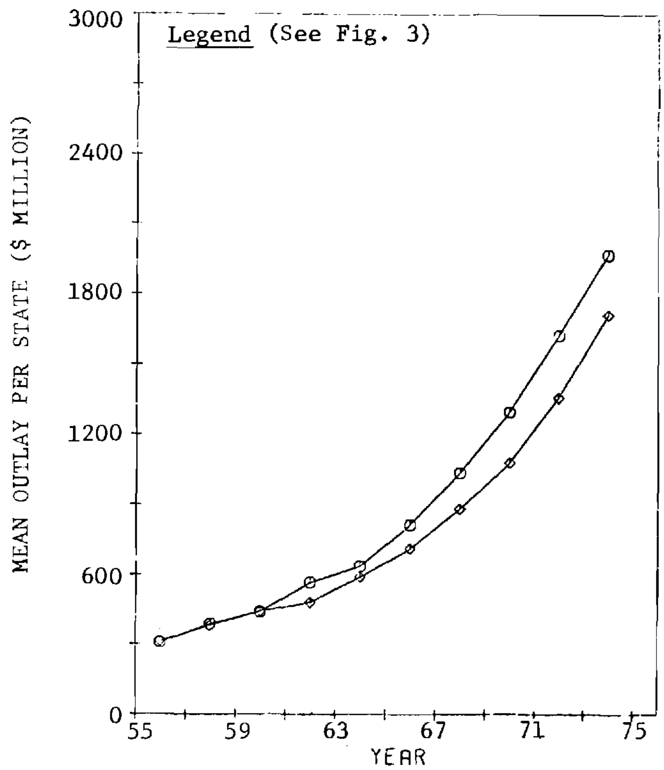

Figure 15. Total State General Outlay

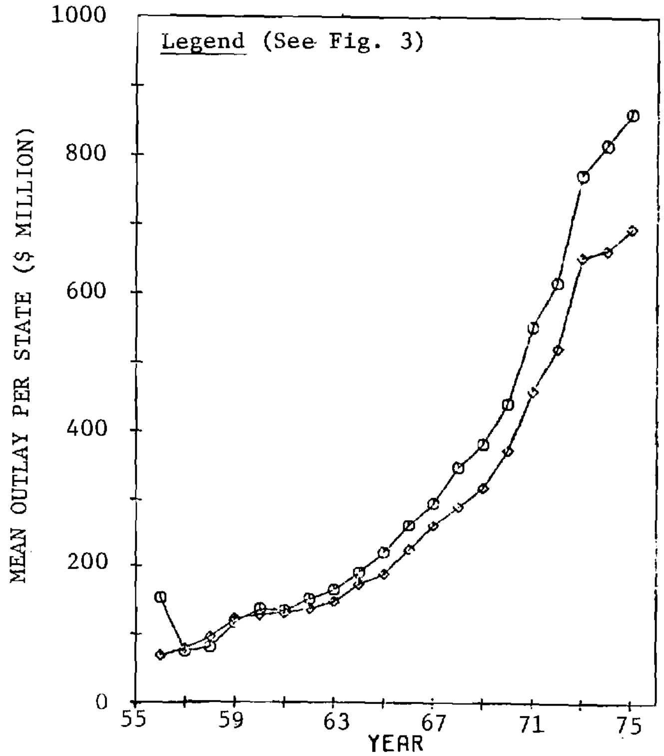

Figure 16. Total Federal Aid to State Government for All Purposes

Table 2. State Highway Bonds - Outstanding Debt at the End of Year ($ Million)

Mean \ Year	1961	1965	1969	1972
Experimental States	216.6	254.6	348.2	488.2
Comparison States	97.1	144.9	171.3	224.3
Difference	119.5	109.7	176.9	263.9

Source: U.S. DOT, Highway Statistics; Summary to 1975, Washington, D.C.

Table 3. State and Federal Gasoline Tax Rates (Cents per Gallon)

Mean \ Year	1961	1965	1969	1972	1975
Experimental States	7.0	7.0	7.4	8.2	8.5
Comparison States	6.7	6.9	7.1	7.4	7.6
Difference	0.3	0.1	0.3	0.8	0.9

Source: U.S. DOT, Highway Statistics, Summary to 1975, Washington, D.C.

B. Relationship Between the ADHS and Other Highway Programs

We will now look at the expenditure profiles for the Interstate, ABC, and non-Federal-aid roads to see if any changes therein correspond with the emergence of the ADHS program. For each system it is potentially interesting to consider:

- total outlay (that is, state outlay inclusive of Federal aid received - this is the indicator of total level of effort on a program);
- Federal aid (Federal expenditures by system);
- state-only outlay (that is, state outlay exclusive of Federal aid received - this is the indicator of the state's level of commitment to a program).[1]

1. Interstate. Given the highly favorable Federal matching share and the time-limited nature of the Interstate program, we anticipated that the ADHS program would not seriously impede Interstate activity. Figures 4, 5, and 6 confirm this conclusion. Note the strong correspondence between total capital outlay and Federal aid reimbursements (Figures 4 and 5) - not surprising given the 90% Federal matching share. From about 1960 on, the core ADHS states maintained an Interstate effort consistently greater than that of the comparison states. However, Figure 6, state-only outlay, hints at a relative suppression of core ADHS state Interstate activities for 1968-70 and 74-75. The 1968-70 slowdown is consistent with the upsurge of ADHS building, however these series are so inherently noisy that this is surely not statistically significant. Even if state Interstate outlays were temporarily

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[1]State-only data are not ideally calculated in the sense that Federal disbursements reimburse the states for their expenditures; hence, a Federal aid expenditure in 1978 may relate to a state outlay in 1977. See Section II.B. for discussion of computational niceties.

restricted, Federal aid remained high, and, consequently, so did Interstate investment relative to the comparison states.

2. ABC. We suspected that the ADHS effort would cause states to cut back on their ABC capital investment. Figure 7 indicates that total ABC capital outlay:

- increased relative to the comparison states after 1966, reflective of the additional ADHS activity going on (and included in A system outlays)[1];
- decreased relative to the comparison states when ADHS outlays are excluded.[2]

In other words, overall effort on these Federal aid roads increased, but the ADHS activity apparently induced some decrement in other ABC system work. (State-only ABC outlays, including ADHS, increased for the core group relative to the comparison states after 1965. State-only ABC outlays, excluding ADHS outlays, decreased slightly, but abruptly from 1966 to 1967. Onset of the ADHS program is the most plausible explanation, but the data are estimates.)

Figure 8 shows the Federal aid for the ABC system (exclusive of ADHS support). This is remarkably constant over time, and, were it plotted in constant dollars (corrected for highway construction cost increases) would show a severe drop from 1958 to 1971 (54% cost increases). This is a critical observation when taken in conjunction with the increase in state-only

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[1]See Section II.B.

[2]Federal ADHS expenditures are available only from 1970; state ADHS expenditures from 1970 are estimated in proportion to the Federal expenditures (0.425:0.575), based on obligation records. ADHS amounts from 1967 to 1969 are based on annual obligations.

ABCD outlays over this period (Figure 9 displays on a constant dollar basis).[1]

These time series on ABC Federal aid and state-only ABC outlay help elucidate a previously confusing result of regression analyses as conducted by Sherman[2] and Rao[3]. Sherman reported a negative coefficient (-1.10, not significantly different from -1) for 1957-70 in a constant dollar regression on total state-only highway expenditures for the 48 continental states. Rao likewise reported a negative coefficient (-3.78, not significantly different from zero) for the period 1967-70 in a constant dollar regression on total capital outlay by state for the five core ADHS states.[4] In a "causal" sense, these coefficients are awkward to interpret. For total state outlay to drop more than $1 for every additional $1 of Federal ABC aid (appropriation), one must assume that each additional Federal dollar not only is used to substitute for a state dollar (ignoring the matching requirement of an additional dollar, given the 50:50 matching ratio at that time), but induces even further reduction in state support! But the catch is the <u>dual assumption of a causal relationship and the inevitable increasing nature of Federal aid</u>. Simply put, what we had in constant dollars, was a period of <u>decreasing Federal aid and increasing state-only outlay</u> (refer to Figure 8, actual dollars; and Figure 9, constant dollars). Thus,

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[1] The D (urban) system was not instigated until 1972; it thus has no bearing on this part of the analysis. It is included to give a consistent series over time - see Section II.B.

[2] Sherman, L. R., <u>op</u>. <u>cit</u>., p. 264.

[3] Rao, S., <u>Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions</u>, a companion paper (Appendix C).

[4] We note that Rao did not obtain a negative coefficient on a 48-state basis (as did Sherman) - his value was (+)0.55.

a negative coefficient reflects that while Federal aid was decreasing, state outlay was increasing. If one wishes to postulate a causal connection (which may not be correct), the reduced availability of Federal aid could have induced the states to invest more of their own funds to meet ABC needs.[1]

Interestingly enough, indications of this fact were observed by Enns in regression analyses (1956-1970) on 48 individual states, but left unresolved. To cite him,[2]

> "One puzzling result concerns the influence of Federal aid authorizations. In almost every state a negative relationship between the rate of increase in aid and (state) expenditure was obtained. In many cases the aid coefficient proved significant in either the current or lagged form of the model...the existence of a negative relationship does not seem plausible since it suggests that the states are out of phase with federal aid policy, increasing expenditures most rapidly when the rate of increase in aid authorization is lowest.

The observation that state-only ABC outlays increased with the beginning of the ADHS program is based upon several confirmatory sources of information. Inspection of Figure 9 suggests this to be likely. Both statistical tests of the interrupted time series assuming a linear model (Mood tests and Walker-Lev tests) and tests based upon a serial correlation model lend support to the notion that the ADHS may have stimulated ABC (including ADHS) investment. Examination of structural equations (regression models) for the core ADHS and comparison groups, before and after the ADHS beginning also indicates a changed ABC situation. These analyses are presented in detail elsewhere.[3]

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[1] This discussion is based on Park, C. Y., op. cit.

[2] Enns, J. H., op. cit., pp. 73-74.

[3] Park, C. Y., op. cit.

Despite the problems in separating A, B, and C data (see Section II.B.), it is instructive to glance at the respective time series. Overall for the ABC systems, we have concluded that state-only and total effort increased when one includes ADHS outlays, but decreased when ADHS outlays are removed (Figure 7). The question of concern, then, is which of the systems (A, B, and/or C) suffered a decline at the expense of the ADHS? Figure 11 suggests a contraction in the Federal aid Primary (A) program, when the ADHS is excluded. Figure 12 implies a significant contraction in the Secondary (B) program (from 1967 on, the core ADHS group actually crosses back under the curve for the comparison group). In contrast, the Urban Extensions (C) program grows substantially faster in the ADHS states! So, the competition of the ADHS seems to have taken its greatest toll on the B program, less on the A, and none on the C. The assumption is that state programming priorities adapted to the ADHS and increasing urban concerns in this manner, but the evidence is limited.

3. Non-Federal-Aid Roads. Under the stress of coming up with the funds for the ADHS program, the states would have seemed to be pressured heavily on their non-Federal-aid construction program. Again, the results are surprising. As indicated in Figure 10, capital outlay on roads ineligible for Federal aid increased in the core ADHS states relative to the comparison group.[1] There is no indication that the ADHS program detracted from the non-Federal aid road effort.

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[1]The explanation does not lie in inclusion of ARC access road expenditures (some of which could so appear). As of December, 1976, the total access road obligations came to only $36.6 million for the 5 core ADHS states (an average of only $7.3 million in over 11 years). This is less than $1 million annually, and, furthermore, very similar to the $62.7 million for the eligible comparison states - Alabama, Mississippi, and South Carolina (yielding an average of $7 million per state for the 9 states of the comparison group).

We have seen that overall highway effort increased and that states generated higher highway revenues by increasing gas taxes and issuing more bonds. It is plausible that, spurred by ADHS needs, states went an extra step to generate additional revenues that could be used on non-Federal-aid roads and to meet matching requirements on the expanding urban Federal aid roadways. In any event, while the ADHS program appears to have constricted the B and A programs a bit, it has not so affected other highway programs.

C. Socio-Economic Impacts of the ADHS

While socio-economic impacts are not a primary focus, it is interesting to gauge the ADHS program in light of such effects. At this time the ADHS is about 50% open to service (1300 miles). Hence, evaluation of its effects is partially based on analogies and forecasts, and partially on actual observed effects.

Appalachia has made useful gains since the onset of the ARC programs:[1]

- the emigration of the early '60's has been reversed to an average immigration;
- between 1960 and 1970 the Region's poverty level people declined by 41%, vs. 30% nationally;
- between 1965 and 1973, Appalachia gained more than one million industrial jobs;
- per capita income rose by 89% from 1965 to 1973, versus 81% nationally;
- the percentage of adults with a high school education and the number of doctors per capita have both increased significantly.

[1] ARC, 1975 Annual Report, Washington, D.C., 1975, pp. 1-2.

While these gains cannot be simply attributed to the ADHS, the highway program has been viewed by the ARC as the cornerstone of development in the Region.[1] When completed, the ADHS and Interstate will be within 30 minutes of 85% of the Region's people.[2] Travel times between twenty major combinations of Appalachian centers and major trading centers should be reduced by 20-50% upon completion of the ADHS.[3] Some 65% of the ADHS mileage passes through or is adjacent to major coal fields[4] - a point conducive to emerging Regional development and national energy concerns.

Various economic benefits appear traceable to the ADHS. Most directly, some 7000 direct jobs and 7000 indirect ones are attributable to construction in 1975 alone (based on general highway construction estimates).[5] Public and private investments have taken place in highway-related businesses and highway-dependent industries. Employment gains from 1962-68 in counties on completed ADHS or Interstate segments outstripped those in other counties.[6] Correspondingly, a survey of 1354 new industrial plant locations in Appalachia found 56% located within 10 minutes of an Interstate or ADHS segment.[7] Another implication of the improved roads is an increase in commuting to work outside the county of residence.[8] In

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[1]Ibid., p. 2.

[2]ARC, The Appalachian Highway Program: Progress, Impacts and Planning for the Future, Washington, D.C., December, 1975, p. 25.

[3]ARC, Highway Transportation and Appalachian Development, Research Report No. 13, Washington, D.C., September, 1970, p. 36.

[4]ARC, 1976 Annual Report, Washington, D.C., p. 7.

[5]ARC, The Appalachian Highway Program, op. cit.

[6]ARC, Highway Transportation and Appalachian Development, op. cit., p. 48.

[7]ARC, The Appalachian Highway Program, op. cit., p. 27.

[8]Ibid., p. 31.

sum, there is support for the assertion that the combined Interstate-ADHS program will provide mobility and economic gains.

D. Comparison of the ADHS and Interstate Programs

As evidenced in the previous section, the ADHS and Interstate programs are intended to be complementary in Appalachia. On a broader front, the two programs present some interesting comparisons. Both are defined networks, with established routes and mileages. They differ in that the Interstate has been funded at a higher Federal share, drawing Federal support from the Highway Trust Fund instead of general funds.

In terms of accomplishment, the ADHS stacks up almost equally with the Interstate. After ten years of program existence, 40% of the ADHS was constructed versus 42% for the Interstate.[1]

Cost to completion estimates rose steeply on both - 92% on the ADHS from 1965-74 versus 86% on the Interstate from 1956-74 (72% during the 1966-74 period).[2] These figures are reasonably comparable given a larger percentage mileage increase on the ADHS, stricter social and environmental concerns, and higher construction cost escalation during the 1965-74 period when the ADHS was getting underway.

Most impressive is the ADHS achievement given the fiscal and other pressures. It has been accomplished while the Interstate development continued at a high level. It has endured the 1973 oil embargo and attendant state financial crunch. And it has taken place without seriously jeopardizing other highway programs (albeit, the B and A capital investments have

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[1] Ibid., p. 24.

[2] Ibid., Appendix A.

slipped somewhat). The achievements of the ADHS program support the viability of special categorical transportation programs possessing characteristics similar to the ADHS (e.g., high state priority).

IV. Implications of the ADHS Funding Parameters

The previous discussion has focused on the impacts of the categorical nature of the ADHS program. That is, we inquired as to the effectiveness and effects of this special designated program being fit into the ongoing state highway activities. In this section, we attempt to unravel the implications of the Federal funding structures set up for the ADHS program. In particular, we treat the matching requirements and the nature of Federal funding procedures.

A. Differential Matching Ratios

One of the favorite funding levers for Federal manipulation in transportation aid programs is the matching requirement. The states and local governments actually face a full gamut of matching demands - from zero on certain Federal programs to total cost on non-Federal-aid programs. In between, the range seems to extend from 50% to 95% Federal share, depending on the program and the recipient. Our interest in observing the ADHS is to detect the effects of different Federal shares. This points us toward:

- differential 2-lane and 4-lane ratios;
- a way to obtain a more favorable Federal share by combining ADHS and Federal-aid ABC support; and
- a change in ADHS and ABC ratios in FY74.

1. 2-lane vs. 4-lane. As displayed in Figure 2, there has been a fascinating series of changes in the relationship between 2-lane and 4-lane ADHS construction matching requirements. The Appalachian Regional Develop-

ment Act authorized and the ARC initially implemented a 70% Federal share (i.e., 30% state match requirement). In 1966, however, due to a perceived shortfall in available funds to construct the ADHS, the 4-lane share was reduced to 50% (although preliminary engineering and right of way remained at 70%). In 1974, all ADHS construction was again authorized at 70% Federal share because the ABC system was so set. Thus, for the main ADHS construction effort to date - August, 1966 through February, 1974 - there was a substantial inducement to construct 2-lane instead of 4-lane ADHS roads.

Rather to our surprise, the evidence indicates that the states roundly ignored this matching differential and predominantly built 4-lane roads. Table 4 presents the best information available on this topic - namely the estimates of projected 2-lane and 4-lane construction at various times, compared with actual construction. From this it is clear that states were not seriously swayed by the matching ratio in determining the number of lanes to construct. Our interviews support this interpretation. For instance, J. Chiles, of Penn DOT, noted that Pennsylvania was moving to high design standards not appropriate for 2-lane roads and set policy to build 4-lanes whenever average daily travel exceeded 5000 vehicles.

2. Non-Use of the Bonus Match. Given states' preference for 4-lane roads, another intriguing option was available to them. To quote,

> "the States are encouraged to finance the remaining half of total project costs with state funds but may elect to finance such remaining portions with a combination of state and other Federal-aid highway funds."[1]

An example is then given that shows how ABC funds can be used to defray another 14% of the costs. The result would be a Federal share of 64% (50%

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[1]ARC, Highway Policy Issues Report, Washington, D.C., June 1974, p. 29.

Table 4. 2-Lane vs. 4-Lane ADHS Estimates and Actual Construction

	2-Lane Mileage	4-Lane Mileage	Total Mileage	% 2-Lane
1963 Estimate[a]	1227	570	1777	69%
1966 Estimate[b]	687	1573	2260	30%
1969 Estimate[c]	553	1729	2282	24%
1972 Estimate[d]	264	2505	2769	10%
1976 Estimate[d]	294	2476	2770	11%
Actual Construction Through June 30, 1972[e]	140	941	1081	13%

[a] Computation derived from Figures 21 and 22 in ARC, Highway Transportation and Appalachian Development, Research Report No. 13, Washington, D.C., September, 1970.

[b] Also from that source, Figure 27.

[c] Same source, Figure 32.

[d] Calculated from the individual state estimates of cost to completion of the ADHS for 1972 and 1976 as indicated. Figures exclude corridor W in North Carolina and corridors T and U in Pennsylvania (total mileage about 84) because these were late additions to the ADHS.

[e] ARC, tabulation dated 10/31/72 (obtained from B. Lewis of the ARC).

ARC, 14% other Federal-aid highway funds). According to W. Aldridge of FHWA and, formerly, the New York Department of Transportation, New York had used the composite ADHS/Federal ABC aid funding scheme once in 1967, but found the red tape to be too oppressive, and from then on, kept projects separate. J. Chiles of Penn DOT amplified the observation that red tape was a nuisance, noting that Pennsylvania often used state-only funds for right-of-way acquisition and preliminary engineering.[1]

This lack of pursuit of available Federal aid needs to be seen in the context of the overall state highway programs. In this time period (1966-73), most states maintained substantial state capital investment levels over and above those required to match available Federal ABC aid. (No Federal aid was allowed to lapse.) Federal aid provided a nice piece of the overall pie, but, by-and-large, it did not alter state ABC highway priorities. That is, Federal aid did not affect the marginal allocation of state effort. It acted as a block grant, helping to meet state needs, not as a categorical program that influenced state priorities. From this perspective, it is quite understandable why states would not care to strain after ABC supplement on the ADHS program - they had plenty of other uses for that available pool of Federal ABC allocations.

In contrast, the Interstate program at 90% Federal share was clearly driven as a categorical program. States invested at the level set by available Federal monies - they put in very little excess (overmatch) state-only funds.[2,3,4] What then about the ADHS? The answer appears to

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[1]In 1965 Pennsylvania embarked on a 10-year, $10 billion highway program intended to maximize highway construction activity.

[2]Sherman, L. R., op. cit.

[3]Enns, J. H., op. cit.

[4]Rao, S., op. cit.

lie intermediate between the "block grant" character of the ABC program and the Federally-driven "categorical" Interstate program. Clearly, the ADHS is a categorical program (see Section III). However, it is one in which the participating states see a strong self-interest. Hence, we see indications that states were willing to invest state funds above those needed to secure available Federal aid. Some segments were constructed at state expense, and, as noted by Chiles, some expenses were borne voluntarily by the states to expedite system development. The following section lends further support to the high priority given the ADHS by the states themselves.

3. Changing ADHS and ABC Ratios. The FY74 increase in ABC Federal matching share from 50% to 70% was viewed as a threat to the progress on the ADHS. In response to ARC query, states indicated:[1]

- All states favored an increase to a 70:30 ratio for 4-lane ADHS construction. However, due to the fact that this would reduce the amount of construction, four states indicated they favored the higher Federal share only if Federal fund authorizations were increased to complete the system.[2]
- A change in funding policy would have very little impact on the priority assigned by the States to Appalachian highways. Most States now assign a high priority to the program and are committed to completion of the system at the earliest date possible consistent with available funding. Only one State had a lower

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[1] ARC, Highway Policy Issues Report, Washington, D.C., June 1974, pp. 30-31.

[2] As discussed in the companion paper by L. P. Rees, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response, an increase in Federal share implies a decrease in effort on a given program for states who meet (rather than exceed) their required matching requirements.

priority assigned to this program than to regular Federal-aid despite the 70-30 ratio on the regular Federal-aid program.

- The States reported no alternative Federal funds to be used on the system or to supplement Appalachian funds. Demands for regular Federal-aid funds far exceed their availability for improvements on other portions of the Federal-aid systems.

The ARC Federal Co-chairman did secure a resolution providing for states to maintain at least the same level of effort as the average for 1969-73, in boosting the Federal ADHS share to 70%.

Table 5 shows the annual total ADHS obligations (not expenditures). The concern is over a potential drop in program effort due to the increased Federal share after February, 1974 and the increased Federal ABC share from FY1974 on. This table and Figure 7 indicate a possible slight dampening of effort on the ADHS, and also on the ABC in the core ADHS states. However, these findings are virtually impossible to interpret because of confounding influences:

- as the ADHS proceeds toward completion, there is less to be done;
- inflation exerts a counter-pressure toward annual cost increases;
- the matching change occurs at the same time as the oil embargo which put a financial squeeze on state highway funds.

It seems most fruitful to consider these recent changes and responses qualitatively. Commitment to the ADHS program appears high (more so in some states), and effort is not solely dependent on Federal actions. Indeed, because of this, the matching ratio is not a critical determinant of program effort, although neither is it irrelevant given the states' financial needs.[1] The states' concern over ADHS system completion, rather

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[1] As states come under fiscal difficulty, matching ratio can become critical.

Table 5. Annual Total (State and Federal) ADHS Obligations ($ Million)

Fiscal Year	Kentucky	North Carolina	Tennessee	Virginia	West Virginia	Total - 5 Core ADHS States	Total - 13 ARC States
66	40	9	10	30	12	101	142
67	16	11	3	21	13	64	117
68	40	9	26	9	58	142	253
69	27	13	15	4	96	155	243
70	58	18	16	9	76	177	318
71	28	9	6	6	114	163	283
72	63	32	30	7	64	196	355
73	69	10	18	10	102	209	301
74	49	5	28	20	48	150	276
75	45	28	20	8	83	185	245
76	37	32	33	22	29	153	208

than just obtaining favorable Federal ratios, is noteworthy.

B. Time Constraints on the Availability of Federal Funds

The procedures for provision of ARC funds to the states underwent a series of changes. From 1969, the ARC allocated funds in proportion to estimated state costs to completion. Initially, the ARC lacked contract authority (present in other Federal-aid highway programs), so they could only allocate appropriated funds - usually several months after the start of a fiscal year. The Commission adopted a policy of reallocation of unobligated funds among the states during the fiscal year to maximize utilization of these funds.[1] The 1967 Amendments to the Act permitted states to expedite the work beyond their allocation of appropriated funds (pre-financing authority), with assurance that the costs would be reimbursed when funds were appropriated and available for obligation, The 1969 Amendments provided contract authority - states could obligate funds as soon as they were allocated by the Commission (six months prior to the FY). The Commission therefore eliminated reallocations but provided for obligational ceilings to be adjusted among states to take advantage of funds available. Throughout this time, there was no effective lapsing of a state's ARC funds - amounts were reallocated based on remaining costs to completion. With FY76 this was changed so that a state could lose up to 30% of its allocation if it did not use it. Those states using all their allocations would be in position to get extra Federal funds.

Two interesting features emerge from this procedural situation. First, the ARC adopted "borrowing" tactics to speed up ADHS construction. States

[1]The series of developments in allocation procedures are described in ARC, Highway Policy Issues Report, Washington, D.C., June 1974, pp. 18-24.

which were obligating all their available funds were given access to the unused allocations (after 1969, obligational authority) of other states. Reportedly, this enabled Virginia, Kentucky, and, sometimes, other states to press ahead, while others, especially Pennsylvania, lagged. The result is a maximal overall ADHS completion rate within the available funding levels, overcoming the slowness of some participants. Indeed, as of December, 1976, Virginia had 65% of its participating ADHS mileage improved to standards; Kentucky, 57%; but Pennsylvania, only 30%.[1]

The second interesting feature is the absence of pressure to get on with the work under threat of losing your Federal allocation (until FY76). This combined with the realization that the full system was authorized, so a state could expect to get Federal funds eventually.[2] The latter point implies that a state might as well wait for Federal ADHS funds, rather than substitute state money. The former point implies no need to rush to use the Federal money; a state's share would "always" be there. Given this secure funding perspective, it is striking that the ADHS has been built so rapidly - a testimonial to the states' own commitments to the system. Some states, again Pennsylvania can be singled out, have lagged. The combination of environmental problems, shortages in matching funds, and the perceived lower priority due to the absence of a threat of loss of Federal funds (ABC funds faced such a threat) resulted in less ADHS activity there.

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[1]Federal Highway Administration, News Release, Washington, D.C., FHWA 15-77, March 21, 1977.

[2]R. W. Duis points out (personal communication) that the states initially did not anticipate that the ADHS program, drawing on general funds, would be extended beyond FY1971. This, along with the already developed plans, prompted them to build as much as possible. Also, there was a threat of "loaning" states losing funds "borrowed" from them - an inducement to proceed quickly.

V. Some Observations

What has been wrought through the ADHS? As discussed, construction of a high quality road system has progressed at an admirable rate. This is attributable to the combination of the Federal ADHS categorical aid program and state commitment to the system. One indication of the state commitment is the state overmatch in ADHS investment (considerable 100% state work in the early years) despite the assured Federal aid. Another is the relative increase in ADHS states' bond indebtedness and gas tax rates. As a result of the road system, mobility gains and economic benefits have developed. Based on our information, the ARC highway programs did little to alter the established planning processes.

As with the Interstate, going the final miles on ADHS completion appears more difficult. The ARC has prioritized segment construction based on need; they have worked on the worst segments first. Hence, the future ADHS investments will edge toward a point of diminished returns. ADHS authorizations extend through 1981, but much more Federal aid will be needed to complete the system. Without such aid the level of construction activity will diminish. Policy deliberations on the future of the ADHS will likely concern energy issues - both in terms of the wisdom of highway expenditures and the ways to promote Appalachian coal transportation (e.g., special Coal-Haul Roads).

This paper has focused on the categorical nature of the ADHS and the efficacy of the Federal funding structures. It has restricted its purview largely to highway considerations. We recall that the ARC effort in transportation is broader, with interests in waterways, railroads, and, air movements. Financially, these involve supplemental aid programs that are deserving of study in their own right. For instance, in the case of ARC supplements to Federal Aviation Administration airport aid and the special Appalachian airport safety funds, it would be useful to find out whether these induced extra investment and of what type.

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX E

ANALYSIS OF STATE HIGHWAY PROJECTS BY FEDERAL AID SYSTEM AND TYPE OF WORK

by

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15. Supplementary Notes

16. Abstract

This report describes an analysis of State highway capital decisions based on examining highway project data obtained from the Federal Highway Administration (FHWA). The data include all State work undertaken with Federal aid and exclude capital improvements on non-Federal aid systems. (while project-level data on capital improvements to non-Federal aid roads are not available, the associated gross expenditures are available from the FHWA and have been used in this report.)

This work is part of a broader study that addresses the effects of funding structures across highway, airport and transit modes.

The report is structured with each of the discrete analysis available separately as follows:

Appendix A, Mass Transit
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

	Page
Acknowledgements	iii
Summary and Recommendations	iv
I. Introduction	1
II. Input Data and Processing	3
A. Data	3
B. Classification of Data	4
III. Findings	8
A. National Trends	8
B. Analysis of Selected State Groups	16
1. New Road Construction	17
2. Highway Allocation in Appalachian States	17
IV. Conclusions	24

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Summary and Recommendations

This report describes an analysis of state highway capital decisions based on examining highway project data obtained from the Federal Highway Administration (FHWA). The data include all state work undertaken with federal aid and exclude capital improvements on non-federal aid systems. (While project-level data on capital improvements to non-federal aid roads are not available, the associated gross expenditures are available from the FHWA and have been used in this report.)

The project level analysis showed that states have dramatically shifted emphasis during the 1970 decade from building new roads to improvement of existing roads. Miles of new roads built annually have declined by 64 percent between 1960 and 1977 while road improvements have increased by 98 percent over the same period.

The states' capital investment on federal-aid roads has failed to keep up with inflation in recent years. Expenditures increased by 43 percent between 1970 and 1977 while inflation increased during the same period by 72 percent.

It is difficult to separate out the reasons for the lower capital investments (much of which is recapitalization) on the highway systems. Continued expectations for inflation and the very slow success of states in enacting higher highway taxes, suggests that federal funds will increasingly become a dominant factor in capital investment decisions.

One can therefore expect that the 1978 Surface Transportation Act will further accelerate the states' current trends toward recapitalization of existing roads and bridges. The Act also gives incentives to those states wishing to accelerate completion of their Interstate systems while at the same time encouraging states with opposite interests to decertify unessential Interstate segments and use the equivalent of those earmarked funds towards other higher-priority ends. The significant federal aid called for by the Act for the nation's deteriorated bridges should evoke a strong response from the states.

Regarding terms of federal aid, since states had already shifted emphasis to road preservation and to bridge improvements in the 1970 decade, one can argue that the federal role, in these two programs at least, is one of providing financial relief as opposed to changing recipient's priorities. Adding the compelling national interest in the preservation of the Interstate System, one can make a good case for increasing the federal matching share, say to 90 percent, in the Interstate restoration and bridge programs.

I. Introduction

This report is part of a second phase in a study aimed at examining effects on State allocative decisions of differences in terms of federal aid for highway programs. Differences include varying matching ratios offered to states, eligibility of only certain states for some federal programs, and categorical versus block nature of some grants. Earlier studies in the first phase have analyzed state expenditure decisions using both statistical multivariate techniques and experimental methods.[1] These studies had used expenditure data classified by function (e.g. maintenance, capital outlay, administration, etc.) and federal system (Interstate, ABC, etc.). This study uses project data obtained from the Federal Highway Administration. These data report the number of projects undertaken, dollar value, and miles of work involved, with classification according to both federal system and type of work, (building a new road, improving an existing road, etc.).

The objective of this alternate approach using project data was to examine changes which have occurred in State allocative decisions over the type of highway work undertaken in the last two decades and of the role

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[1] Porter, A.L., Park, C.Y., Rees, L.P., Connolly, T., Rao, S., and Larson, T.D. Effects of Federal Transportation Funding Policies and Structure, Office of the Secretary, U.S. Department of Transportation, Washington, D.C., 1980.
Sherman, L. The Impacts of the Federal Aid Highway Program as a Policy Intervention, Unpublished Ph.D. Thesis, Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts, February 1975.
Park, Y. Analysis of the Appalachian Development Highway System as a Policy Intervention. Unpublished Master of Science Thesis, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, Georgia, August 1978.

federal aid terms may have played in these decisions. This report is also different from earlier studies in that it focuses only on decisions <u>within the capital</u> program for <u>federal-aid</u> systems. Since the data analyzed here exclude state capital expenditures on non-federal aid roads, it is not possible, on the basis of these data alone, to draw conclusions about overall state capital investment levels. However, one can infer changes in relative priorities among different federal aid systems and drawing upon earlier studies remark on the overall highway programs.

Care must be exercised in interpreting expenditure data on federal aid system categories because of changes which have occurred in system definitions. Based on extensive discussions with U.S. Department of Transportation personnel, allowance has been made for these changes in the findings reported here. Greater confidence is placed on the classification by type of work.

The report is organized as follows. The next section describes the source of the data and the processing of these data. The following section describes the findings, first identifying certain national trends and then examining selected groups. The final section presents the conclusions.

II. Input Data and Processing

A. Data

Data for this study came from the PR-37 Master file. The PR-37 is a collection of highway project information for all fifty states and five U.S. possessions. The data are arranged alphabetically by state name and include all projects from 1957 to present.

The PR-37 Master file is compiled by the U.S. Department of Transportation, Federal Highway Administration. The file is updated periodically as projects are undertaken and completed. Within the file are five different record formats that correspond to different uses of the Master file. The record formats and uses are as follows:

Header Record. This is the first record for all project information. It includes the project location, character of proposed work, expenditures total to date. The header record serves as an overview of introduction to a highway project.

Detail Record. The detail record is the most useful record type to categorize project information. Total project cost, federal funds, system classifications, and construction type are among the information contained in this record type.

The detail record also lists stage 1 and stage 2 authorization, progress and completion dates for all projects. This analysis uses the stage 2 authorization date to analyze project information over time. The authorization date on the PR-37 is the date federal funds were obligated for a project.

Summary Record. The summary record format is used to record projects authorized prior to July, 1956. This is a listing of projects where federal funds were authorized, but the project was never started. Projects appearing on the summary record are part of the Department of Transportation's inactive file.

Cost Estimate Record. This record type is used to record estimated costs before a project is undertaken. Any project appearing in this record format is simply a proposed project for which federal funds have not been authorized. For purposes of the analysis, any project appearing in a cost estimate record is ignored. The analysis is concerned only with projects where federal funds are authorized.

Audit Trail. The audit trail record is used for accounting and control purposes. The record contains information on the number of projects, total cost, and subsidiary federal funds for each state.

B. Classification of Data

The analysis centers on two types of project classifications: type of improvement and federal aid system. The classification, according to type of improvement, was accomplished using the construction class from the detail record format. Five project type groups were formed as follows:

A New Road (construction code 0 and 1) is considered to be either: 1) construction of a traffic facility at a new location, or 2) relocation of an existing route that promises to carry all the through traffic of the old route.

A Road Improvement (construction code 2,3,4, and 5) is construction on an existing route. This may include a minor relocation, resurfacing, widening, or combination.

A New Bridge (construction code 6) is construction of a bridge where one did not previously exist.

A Bridge Improvement (construction code 7,8, and 9) is any construction on an existing bridge. This may include major reconstruction, widening, or paving.

Unclassified (construction code blank) encompasses engineering, purchase of right-of-way, or miscellaneous construction. This category primarily consists of preliminary studies.

A second dimension used for classifying projects was the federal-aid system of the road on which the improvement occurred. Projects are classified into ten different system classifications in the PR-37 file. However for the purpose of this study, these were reduced down into five groups: Primary, Secondary, Urban, Interstate, and Other.

The Federal Aid Primary System. The Primary System (A) was established in 1921 and is the oldest of the federal aid systems. It was designated as a system of main highways not to exceed 7 percent of each state's total highway mileage.

Authorizations for the Primary System are made every two years. Apportionment of the authorizations is based on the following factors:

1) 2/9 land area
2) 2/9 rural population
3) 2/9 rural postage route mileage
4) 1/3 urban population

It is also provided that no state will receive less than .5 percent of the total apportionment in a given year.

The Federal Aid Secondary System. The Secondary System (B) was intended to aid rural roads which link markets to urban centers. This system typically includes mail routes, public bus routes, and county and township roads, and the projects are generally of smaller scale than primary projects.

Authorizations for the Secondary System are also made every two years. Apportionment of the authorizations is based on the following formula:

1) 1/3 land area
2) 1/3 rural population
3) 1/3 rural postal route mileage

The Federal Aid Urban System. The Urban System was established by the

Federal Aid Highway Act of 1970. It was intended to be a new and separate system serving major centers of activity in urban areas. Apportionment of urban funds is based on urban population over 5,000.

The Federal Aid Interstate System. The Interstate System is quite different from the systems discussed above. First, total mileage of the Interstate System has been specifically identified and constrained, initially at 41,000 miles, and now at 42,500 miles. Also, completion of the Interstate System was scheduled for the end of 1979, but since has been extended. This is the only Federal Aid System that was established with a limit on the total mileage and with a target completion date. Apportionment of Interstate funds is based on the federal share of the estimated cost of completing the Interstate System and the federal matching share is very high, at 90 percent.

Other. All other types of road systems including Offsystems and Highway Planning and Research (HPR) expenditures are grouped in this category.

III. Findings

The findings of this study will be discussed in two parts. First, the national trends and then the trends for selected groups of states will be examined.

A. National Trends

Tables 1, 2, and 3 show the total number, dollar value, and miles of work respectively for highway projects in the PR-37 Master file. Projects are placed in the five improvement type categories described previously. The tables show that:

- The total dollars devoted to highway construction and improvement have failed to keep up with inflation in the industry, especially in the 1970's. The expenditures increased from $6.7 billion in 1970 to $9.6 billion in 1977, an increase of 43 percent, while inflation increased during the same period by 72 percent.[1]

- Emphasis in project type has shifted dramatically from the building of new roads to improvement of existing roads; for example, 1,959 miles of new roads were completed in 1977 compared to 2,413 miles in 1975 and 5,199 miles in 1965. Road miles improved increased to 13,147 miles in 1977 from 8,629 miles in 1965.

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[1] Federal Highway Administration, Price Trends for Federal-Aid Highway Construction, highway composite index, various years, Washington, D.C.

Table 1. Total Number of Projects by Type and Selected Years

	New Road	Road Improvement	New Bridge	Bridge Improvement	Subtotal	Unclassified[1]	Total
1960	2,474	2,334	3,137	338	8,283	15,604	23,887
1965	2,098	2,368	3,319	311	8,096	16,666	24,762
1970	1,623	1,440	2,145	224	5,432	16,131	21,563
1975	1,285	3,577	1,918	656	7,436	28,521	35,957
1977	1,179	5,768	2,206	1,069	10,222	34,535	44,757

[1] Preliminary engineering, right-of-way acquisition, and miscellaneous construction--primarily preliminary studies.

Table 2. Total Dollar Value of Projects by Type and Selected Years (millions)

	New Road	Road Improvement	New Bridge	Bridge Improvement	Subtotal	Unclassified	Total
1960	$1,555.5	571.4	801.9	40.3	2,969.1	1,514.4	4,483.5
1965	2,071.4	674.5	978.1	38.2	3,762.2	1,699.0	5,461.2
1970	2,421.4	862.6	1,408.2	56.6	4,748.7	1,971.8	6,720.5
1975	2,038.6	2,016.5	1,481.7	218.5	5,755.4	2,663.1	8,418.5
1977	1,869.1	2,702.1	1,686.3	323.9	6,581.5	3,037.8	9,619.3

Table 3. Road and Bridge Miles by Type and Selected Years

	New Road	Road Improvement	New Bridge	Bridge Improvement	Subtotal	Unclassified	Total
1960	5,379.0	6,643.1	139.8	10.9	12,172.8	35,374.4	47,547.2
1965	5,199.0	8,628.7	128.4	12.4	13,968.4	22,276.9	36,245.3
1970	3,535.3	4,542.4	112.9	12.3	8,203.0	16,973.0	25,176.0
1975	2,413.3	7,892.7	102.7	63.5	10,472.2	17,241.9	27,714.1
1977	1,958.8	13,146.8	176.4	111.9	15,393.9	19,798.7	35,192.6

- Due to inflation, the current dollar amount of expenditure on new road construction has remained approximately constant despite the reduction in number of projects.

- The bridges in the nation have begun to receive greater attention. Bridge improvement projects increased from 311 in 1965 to 1,069 in 1977 with a concomitant increase in project value from $38.2 million to $323.9 million.

- All categories of projects, in terms of road miles built and improved, declined after 1965 and fluctuated around a lower plateau of activity until 1975. Since 1975, improvement of existing roads and bridges has received greater resources.

- The number of <u>miles</u> of project work underway in preliminary stages (engineering, right-of-way, etc.) has remained approximately constant since 1965 at about 20,000 miles. However, the number of projects in preliminary stages has increased from about 16,000 in 1965 and 1970 to 28,521 in 1975 and 34,535 in 1977, suggesting that projects are now of smaller scope.

Tables 4 and 5 show the total number and dollar value of highway projects by type of federal aid system. The Urban System, as described earlier, was not established until 1970 and prior to this time these roads were either part of the Primary and Secondary road systems or local non-federal-aid systems. Table 6 compares road and bridge miles for 1965,

Table 4. Number of Projects by System and Selected Years[1]

	Interstate	Primary	Secondary	Urban	Other	Total
1960	3,219	3,931	994	1	138	8,283
1965	3,631	2,740	1,659	0	66	8,096
1970	2,387	2,109	856	0	80	5,432
1975	1,741	2,607	1,879	860	349	7,436
1977	1,939	3,492	1,850	1,443	1,498	10,222

[1]Excludes "Unclassified projects

Table 5. Total Dollar Value of Projects by System and Selected Years (millions)[1]

	Interstate	Primary	Secondary	Urban	Other	Total
1960	$1,732.9	1,102.9	120.2	-	13.1	2,969.1
1965	2,504.2	981.9	265.6	-	10.5	3,762.2
1970	2,956.1	1,569.0	201.7	-	21.9	4,748.7
1975	2,647.7	1,994.2	585.3	471.8	56.4	5,755.4
1977	2,818.2	2,349.5	543.9	683.6	186.3	6,581.5

[1]Excludes "Unclassified" projects

Table 6. Road and Bridge Miles by Type and Systems for 1965, 1975, and 1977

	New Road	Road Improvement	New Bridge	Bridge Improvement	Subtotal	Unclassified[1]	Total
Interstate							
1965	3,317.2	744.0	78.4	2.3	4,142.0	7,212.1	11,354.1
1975	1,175.8	970.2	33.6	21.5	2,201.1	3,633.9	5,835.0
1977	791.4	1,626.2	51.9	21.1	2,490.6	4,127.7	6,618.3
Primary							
1965	1,582.1	3,635.9	32.6	7.9	5,258.5	4,571.1	9,829.6
1975	813.1	3,595.0	27.1	32.3	4,467.5	5,553.6	10,021.1
1977	845.7	6,218.8	42.9	25.2	7,135.7	6,699.5	13,832.1
Secondary							
1965	278.4	3,864.1	17.4	2.1	4,162.1	9,524.5	13,686.6
1975	316.9	2,352.5	34.8	4.8	2,709.0	5,289.6	7,998.6
1977	191.2	3,247.9	48.6	11.1	3,498.6	4,807.6	8,306.4
Urban							
1965	-	-	-	-	-	-	-
1975	71.7	407.8	5.6	3.9	489.1	656.6	1,145.7
1977	79.7	872.3	12.5	47.5	1,011.8	2,000.4	3,012.2
Other							
1965	21.3	384.7	-	-	405.8	969.2	1,375.0
1975	35.8	567.2	1.6	1.0	605.5	2,108.2	2,713.7
1977	50.8	1,181.6	20.5	7.0	1,257.2	2,163.5	3,423.6
Total							
1965	5,199.0	8,628.7	128.4	12.4	13,968.4	22,276.9	36,245.3
1975	2,413.3	7,892.7	102.7	63.5	10,472.2	17,241.9	27,714.1
1977	1,958.8	13,146.8	176.4	111.9	15,393.9	19,798.7	35,192.6

1975, and 1977 with projects classified by both type of work and federal-aid system. These tables show that:

- Over time, as the Interstate System has neared completion (it is now about 90 percent complete), the number of miles of project work involved has declined from 11,354 miles in 1965 to 5,835 miles in 1975. However, the Interstate project work remains and will continue to be an important component of highway work in the nation because (1) the system is expensive with average project cost of $1.2 million per mile compared to $0.4 million per mile for a Primary project (in 1975); and (2) much of the Interstate System continues to require on-going improvement as many parts of the system near the end of their 20-year life. In 1965, 744 miles were improved and this activity increased to 970 miles in 1975 and 1,626 miles in 1977.

- In comparison with the high point of the highway construction era in 1965, roads on the Primary and Urban Systems and the nation's bridges are receiving greater attention. This gain is afforded by drawing away some resources from the Interstate and Secondary System roads.

- Examination of projects in the preliminary stages suggest that for the next few years, states will continue to give high priority to Primary and Urban routes.

The above trends appear to be a natural outgrowth of several basic phenomena in the United States: (1) Slower population growth and a concentration in urban and suburban areas; (2) a national network of high-speed corridors linking virtually every major activity center; (3) rapid increase in highway maintenance costs due both to inflation and the increase in the size of the highway network, resulting in fewer resources available for new construction; (4) a highway network whose average age is increasing as many segments of system, built during or prior to the 1950's and early 60's reach their expected life and require rehabilitation or reconstruction; (5) higher environmental concerns and greater uncertainty in highway revenues (due to the move to lower energy consumption) leading to more difficulty in undertaking and greater reluctance to committing scarce resources to expensive, long-term projects.

While the above are national phenomena, they have not affected all states equally. For example, the migration of people from the Northeast to the South and the Southwest has led to greater highway revenues and greater demand for highway services in the latter states. Therefore, one might expect differences in allocation of resources, with Southern and Southwestern states allocating relatively more resources to new road construction. In the Appalachian states, the federal Appalachian Development Highway System (ADHS) is considered to have boosted highway programs.[1] These suppositions are examined in the next section.

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[1] Park, C.Y., _op_. _cit_.

B. Analysis of Selected State Groups

States were grouped into several different classifications following earlier work along similar lines.[1] Analysis of the following groups of states turned out interesting results.

Public Land: Some states have a considerable amount of publicly-owned lands. These lands, which are non-taxable, have the effect of reducing state revenues. To compensate states for this reduced revenue, the Congress allowed higher federal matching ratios on several federal-aid programs. There are twelve continental states that qualify for more favorable matching shares under this provision: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming.

Appalachian States: The Appalachian Development Highway System (ADHS) was established by Congress in 1965. In broad terms, the objectives of the ADHS are to foster economic development through increased mobility. Highway projects on the ADHS are financed out of general funds. Thirteen states are eligible under this program: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia.

Core Appalachian States: Five of the Appalachian states are termed "core" states. These states received substantial monies through their

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[1] Porter, A.L., Park, C.Y., Rees, L.P., Connolly, T., Rao, S., and Larson, T.D., *op. cit.*

early participation in the ADHS program. This group consists of: Kentucky, North Carolina, Tennessee, Virginia, and West Virginia.

1. New Road Construction

New road construction in the nation has shown a dramatic decline as graphically depicted in Figure 1. However, construction in the Appalachian region has increased since 1973. In 1978, this program received over 37 percent of the resources in the Appalachian region, compared to 20 percent in the nation as a whole. The proportion of projects involving new road construction in Appalachia is also higher; 4.8 percent in 1978 compared to 2 percent for the nation. It should also be noted that of the various groups analyzed, the Core Appalachian States are the only group that can point to an increase in new road construction in the 1970's.

The groups that exhibit the most noticeable turndown in new road construction are Public Land States. In these states the proportion of total dollars going toward new road construction has fallen from 33 percent to 9 percent in recent years. In contrast, Southern States exhibit a stable program of new road construction with about 30 percent of total project expenditures going toward this purpose.

2. Highway Allocation in Appalachian States

Nationally, there has been a trend to allocate more resources to non-federal-aid systems as graphically shown in Figure 2. The expenditure on roads with only state funds involved (i.e. without federal aid) increased

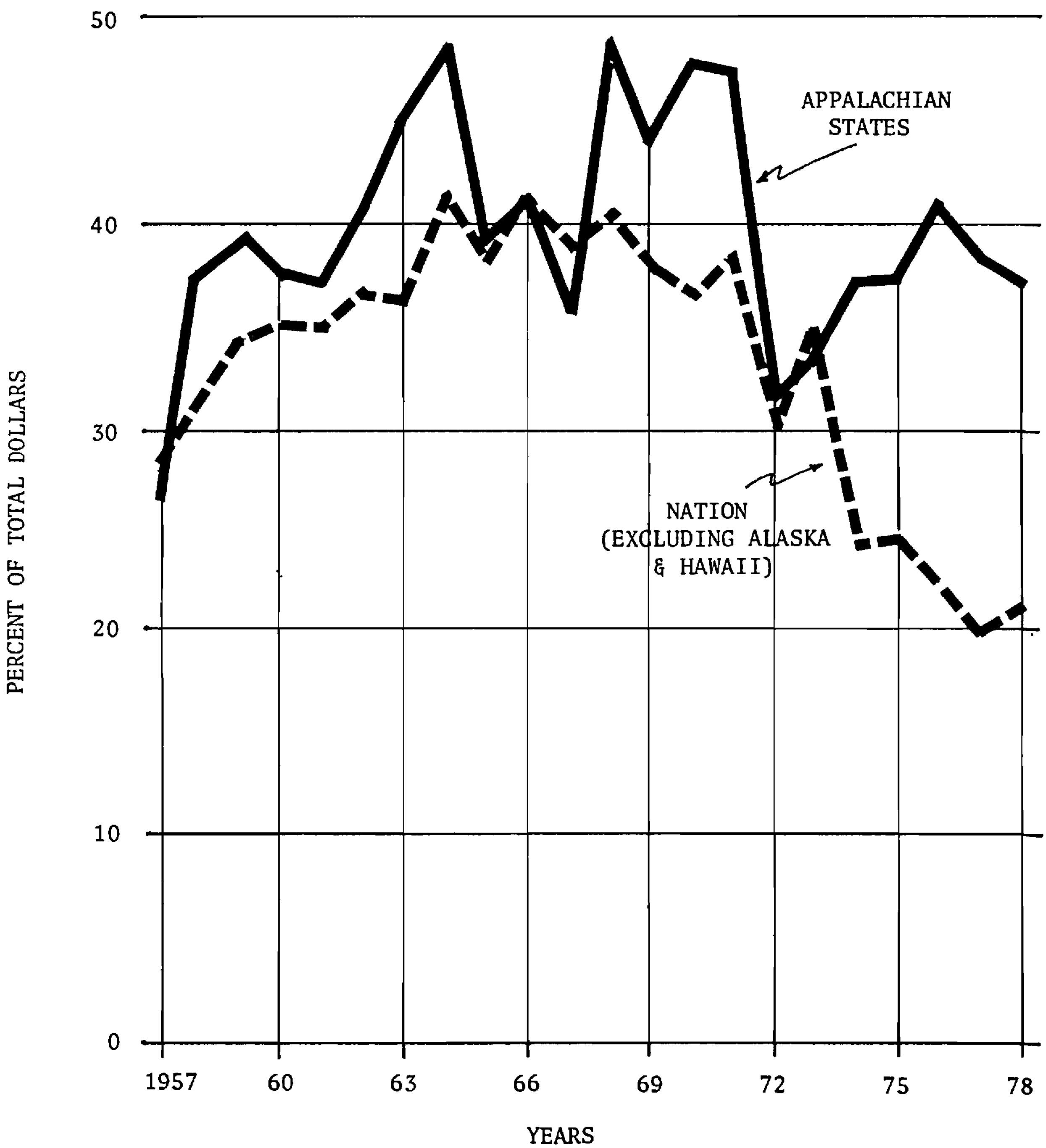

Figure 1. ALLOCATION OF HIGHWAY RESOURCES TO NEW ROAD CONSTRUCTION, NATION VS. APPALACHIAN STATES

Source: Federal Highway Administration, Highway Statistics, various years, Washington, D.C.

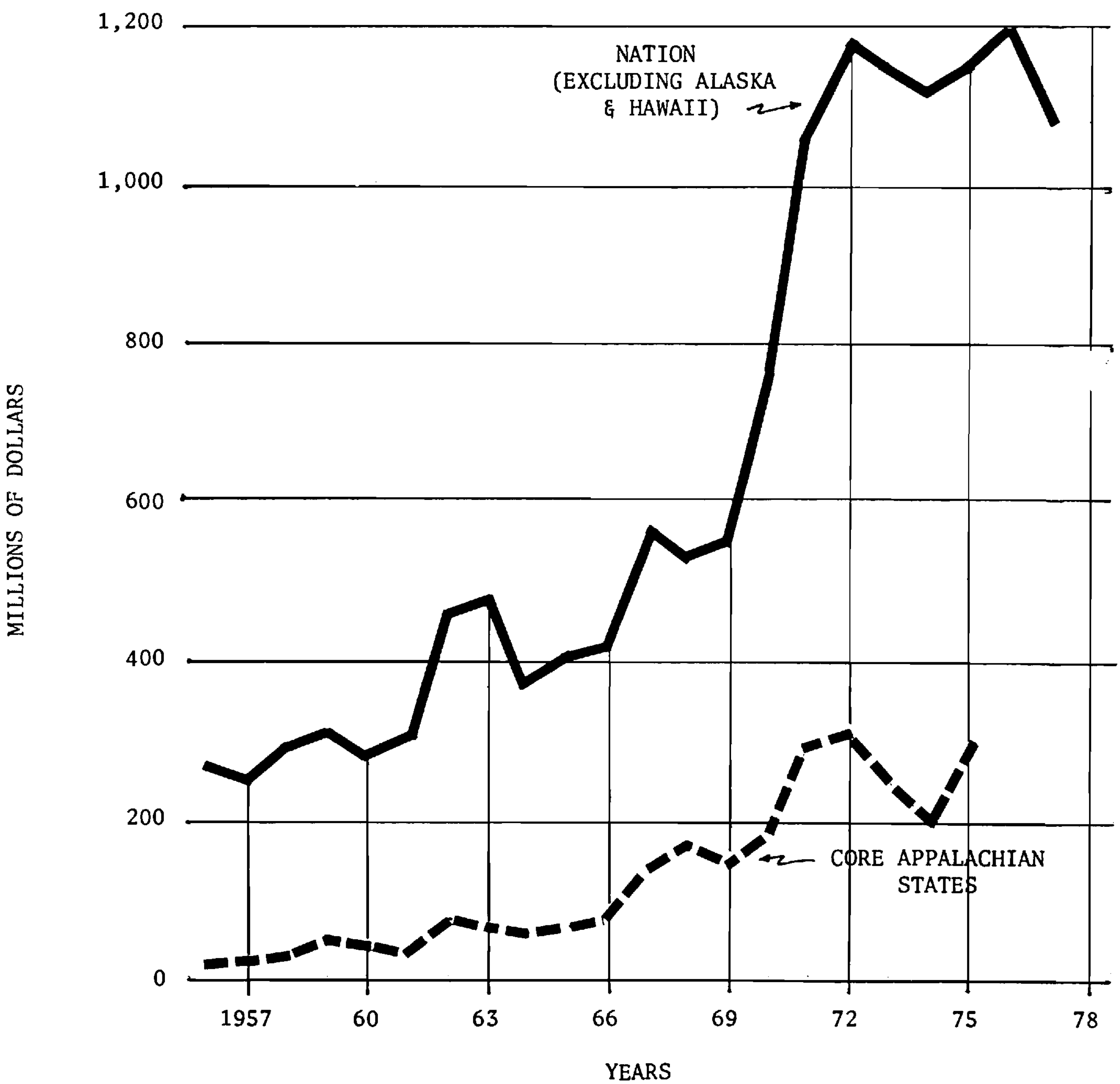

FIGURE 2. HIGHWAY RESOURCES DEVOTED TO NON FEDERAL AID SYSTEMS, NATION VS. CORE APPALACHIAN STATES

markedly in the early seventies. This is most likely due to the increasing "red tape" perceived with major federally-aided projects as a result of the passage of the National Environmental Policy Act in 1969. The subsequent stabilization in expenditures on the 100 percent state program may be due to the awakening of environmental concerns in state level legislation as well as increasing scarcity of resources. Recent federal action allowing states to obtain (in some cases borrow as in the ADHS program) unused federal apportionments have also created incentives to seek federal dollars to the maximum extent possible with matching state dollars.

The Core Appalachian states also exhibit increasing expenditures on non-federal-aid roads, despite the drain upon highway resources of the ADHS program. It has been stated:[1]

> . . . . .capital outlay on roads ineligible for Federal Aid increased in the core ADHS states relative to the comparison group. There is no indication that the ADHS program detracted from the non-federal-aid road effort.

The data presented in this study confirm these findings.

Figures 3 and 4 show the share of project funds allocated in the Appalachian states to Primary and Secondary road systems, respectively. The Primary System share doubled from 20 to 40 percent over the 1965-75 decade, coinciding with the introduction of the federal ADHS program. Roads improved through ADHS funds became part of the Primary System upon completion.

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1 Ibid.

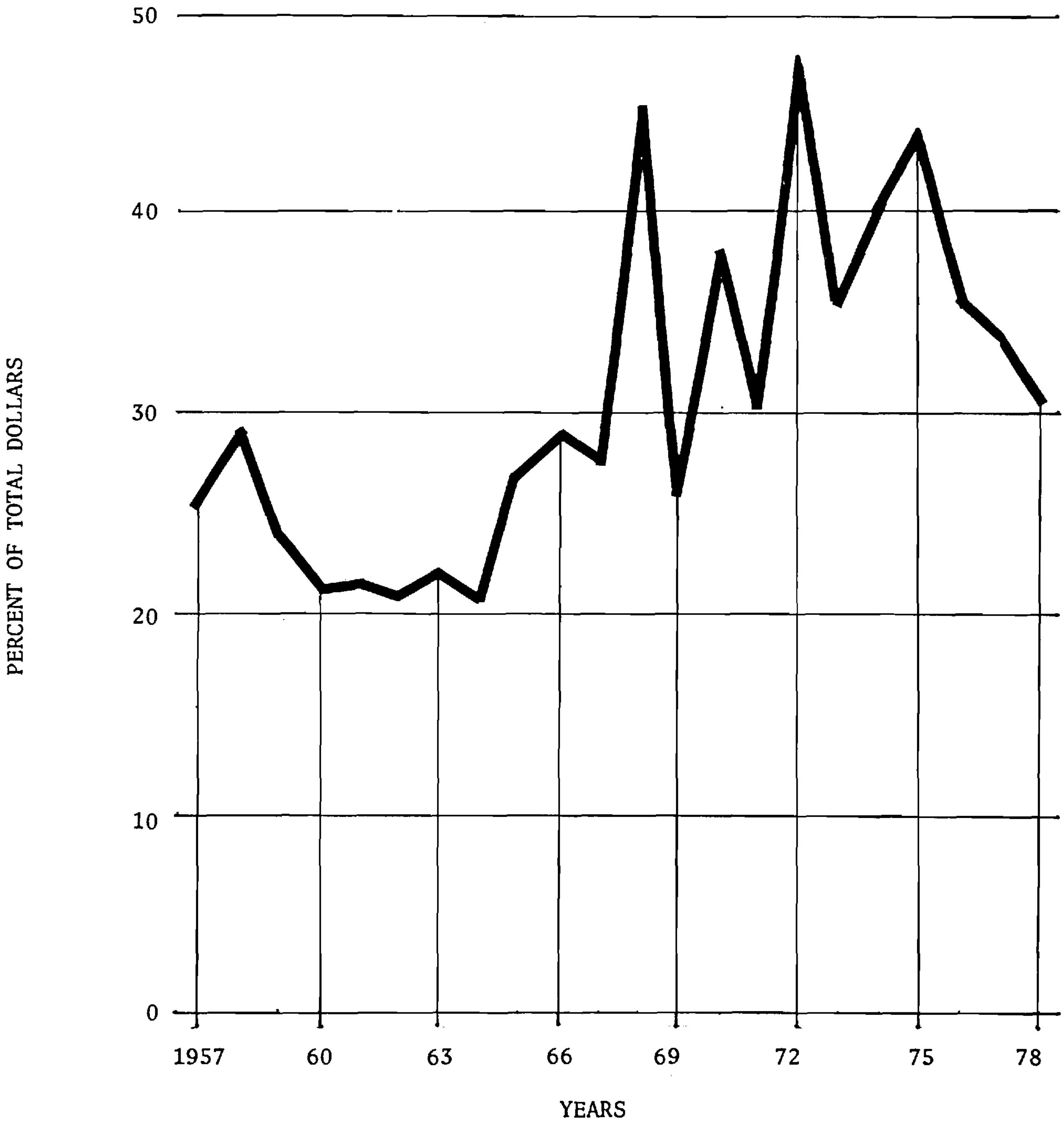

FIGURE 3. ALLOCATION OF HIGHWAY RESOURCES TO THE PRIMARY SYSTEM IN APPALACHIAN STATES

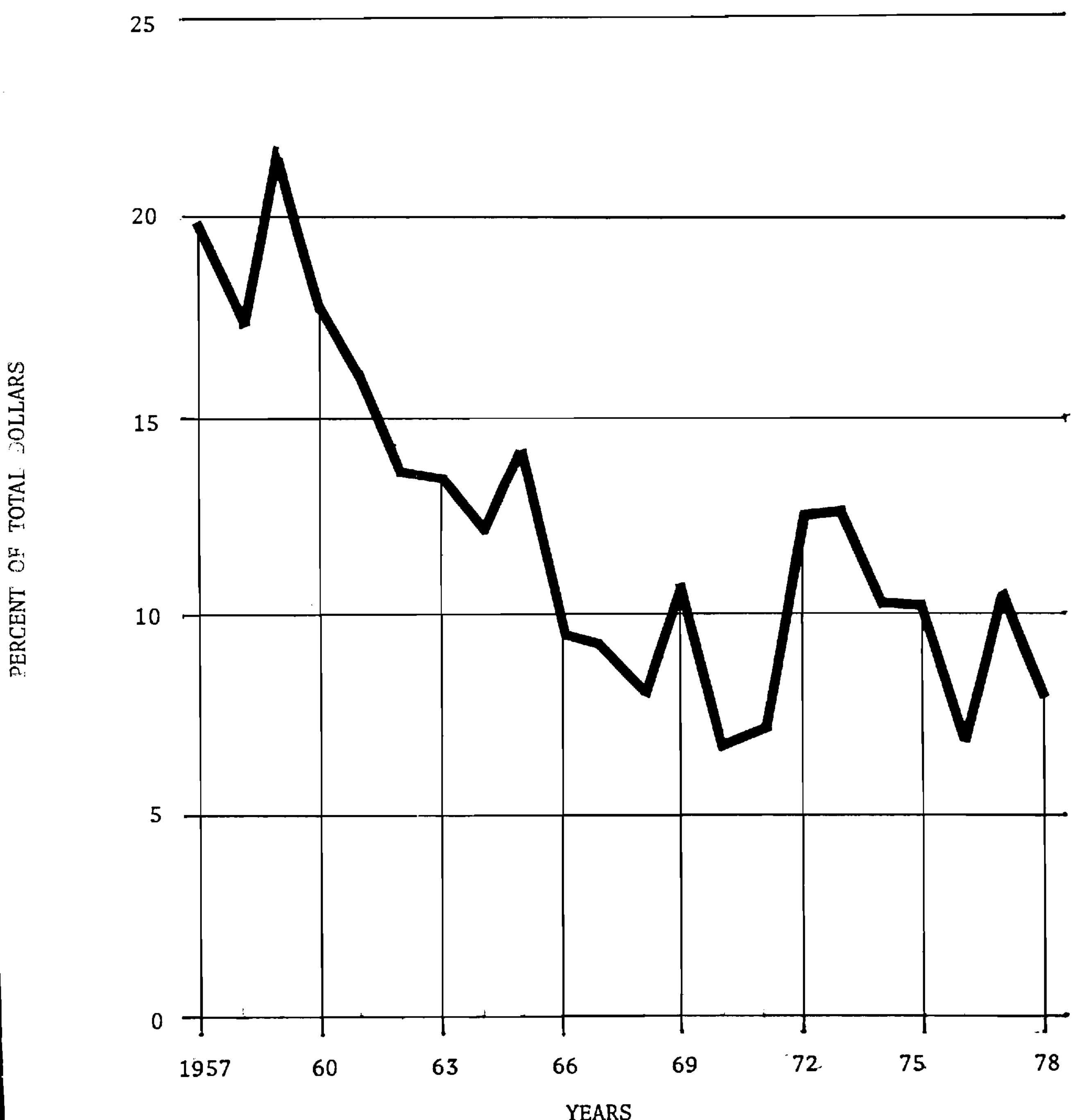

FIGURE 4. ALLOCATION OF HIGHWAY RESOURCES TO THE SECONDARY SYSTEM IN APPALACHIAN STATES

The Secondary System share shows a long-term decline in the Appalachian states. First, the Interstate program and then the ADHS program (as manifested in the Primary System) seem to have drawn higher priorities at the expense of the Secondary System.

IV. Conclusions

Analysis of project data for the past twenty years reveals several shifts in state allocative decisions over time. Perhaps the most important of these shifts is that from the building of new roads to the improvement of existing roads. The latter improvements include reconstruction as well as resurfacing and other betterment projects.

New road construction was at its peak in the 1965-1968 period as the federal Interstate program poured massive resources at attractive matching terms. As the Interstate System nears completion, states have started giving greater attention to the Primary, Urban, and Non-Federal Aid Systems. Bridges are also receiving more funds as states perceive a critical problem with a system of structures which is old, deteriorated, and not built for today's traffic volumes and truck weights.

As an exception to the national trend, new road construction continues at a high pace in the Appalachian states where the ADHS program is having a stimulative effect on highway construction similar to that which the Interstate program had on the nation as a whole in the 1960's. If the Interstate and Appalachian programs serve as examples, the federal expanded Bridge program, as authorized in the 1978 Surface Transportation Act, should accelerate the current attack on our bridge problems.

EFFECTS OF FEDERAL TRANSPORTATION FUNDING POLICIES AND STRUCTURES:

APPENDIX F

THE AIRPORT DEVELOPMENT AID PROGRAM: IMPLICATIONS OF A CHANGING FEDERAL AID PROGRAM

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15. Supplementary Notes

16. Abstract This analysis concerns the manner in which the Airport Development Aid Program (ADAP) funding provisions have affected airport development. It focuses on the implications of changing Federal shares as the act was revised for the fiscal year (FY) 1974-75 period, then again for FY 76-78. The level of Federal funding, the way in which funds are allocated, and the restrictions on their usage are also considered.

This work is part of a broader study that addresses the effects of funding structures across the highway, transit, and airport modes.

The report is structured with each of the discrete analysis available separately as follows:

Appendix A, Mass Transit
Appendix B, Highway Matching Requirements and Funding Levels: A Preliminary Model of State Response
Appendix C, Statistical Analysis of the Impact of Federal Highway Aid on State Allocative Decisions
Appendix D, The Appalachian Development Highway System
Appendix E, Analysis of State Highway Projects by Federal Aid System and Type of Work
Appendix F, The Airport Development Aid Program: Implications of a Changing Federal Aid Program

The underlying philosophy is presented in the Overview Report.

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Table of Contents

	page
Summary	iii
I. Introduction	1
II. Airports and the Federal Government	2
III. ADAP	4
IV. Effects of Overall Increase in Federal Funds	12
V. Uses of Funds	15
A. Improvement Versus New Airport Construction	15
B. Categories of Use, and Categories of Users	16
C. Investments Versus Enplanements	20
VI. Concluding Observations	23
A. Implications of the Analysis	24
B. Some Observations on 1980 Legislative Proposals	29

Summary

This analysis concerns the manner in which the Airport Development Aid Program (ADAP) funding provisions have affected airport development. It focuses on the implications of changing federal shares as the act was revised for the fiscal year (FY) 1974-75 period, then again for FY76-78. The level of federal funding, the way in which funds are allocated, and the restrictions on their usage are also considered.

This work is part of a broader study for the Office of the Secretary, U.S. Department of Transportation (P. J. Barbato, monitor) that addresses the effects of funding structures across the highway, transit, and airport modes. We deeply appreciate the insights offered on current and future policy issues by the many knowledgeable transportation professionals acknowledged in our overview report.

The findings presented reflect a synthesis of statistical analysis, interview, and literature review. The statistical base is the record of Federal Aviation Administration (FAA) financial assistance projects under the ADAP program from FY71 through FY77. Interviews with a number of professionals concerned with aviation from different perspectives augment this data base. Several analyses focused on different aspects of airport financing contribute to the present interpretations.

ADAP had markedly increased the level of federal involvement. Total investment under ADAP has grown to some $700 million in FY77, but sponsor contributions actually declined from well over $200 million in FY72 to about $150 million in FY77. We have reason to believe that large airports (large and most medium hubs) invest considerably beyond ADAP, but that smaller ones do not. Since FY74 the share going to general aviation airports has declined from about 21% to 12% in FY77, with the actual dollar amount for general aviation about constant as the ADAP program has grown. Just within the air carrier airports, proportionately more funds per enplanement have gone to the smaller airports to a striking degree.

The federal aid share for ADAP from FY71-73 was 50%; for FY74-75 it increased to 75% for the medium hub and smaller airports. For FY76-78 it increased to 75% for the large hubs, with no change for the medium hubs, but an increase to 90% for smaller airports. We investigated the effects of these changes, comparing among large, medium, and smaller hubs for the three time periods. No general pattern emerged to suggest that federal share was a dominant influence on investments.

Almost 98% of the ADAP funds have gone to improvement of existing airports rather than construction of new ones (for a variety of reasons). Almost 75% of the funds have been used for landing area construction, other land, and site preparation. A category that includes relocation costs, safety and security, and environmental land has increased dramatically (most sharply for medium hubs - from 8% in FY71-73 to 27% in FY76-77).

We consider federal funding intent to be critical in assessing a federal aid program. A program of compelling national interest, for

instance, may warrant a high federal aid share in a tightly categorical program. If one wants to stimulate local investment, a lower federal share to maximize leverage in a categorical program would be appropriate. If the intent is to reduce the financial burden on a local transportation unit, more flexible block grants with high federal shares are in order. From this perspective, ADAP has increased investment, especially for safety purposes (a national interest). However, one could question whether the sharp growth in capital costs per enplanement at small airports, at Trust Fund expense, is fully warranted. If ADAP is viewed largely as a mechanism to effect user funding, it has worked, although changes are now under consideration. The analysis concludes with a brief discussion of currently proposed legislative changes.

We generally conclude that flexibility is desirable in federal aid programs. This implies a preference for block grants over categorical programs in the absence of strong counter-arguments. It also argues for discretionary rather than formula programs, although formula programs have administrative advantages.

I. Introduction

For many years, and particularly in the past decade, the federal government has made efforts to shape the growth and development of the nation's airport system. In large part, these efforts have involved the provision of various forms and amounts of financial aid for airport construction by local sponsors. Two large federal programs have provided such aid: the Federal Aid to Airports Program (FAAP), extending from 1947 to 1970; and the Airport Development Aid Program (ADAP), instituted with fiscal year (FY) 1971 and since extensively modified in 1973 and 1976. Under both programs, but especially under ADAP, a number of 'policy levers' have been manipulated: the total amount of federal aid provided; requirements for recipients to contribute; eligibility of different categories of recipients; restrictions on categories of investment; and the form of aid provided. The objective of this study is to assess the effects of these funding policies and changes therein on actual airport construction activity.

Given the large dollar amounts involved in airport construction, and the important role played by airports in the national transportation system, an assessment of the impact of federal government interventions in this area is clearly of interest in its own right. Further, the examination of these issues promises insights into larger questions of federal intervention in transportation funding decisions. The airport funding area provides an interesting opportunity to assess the impact of the various financial 'policy levers' noted on such 'output variables' as total construction activity; distribution of expenditures across different categories of construction, and across different categories of airports; and so on. A particular focus of interest is the effect of increasing the federal share of project cost: Has this led to broader participation by smaller airports? Has it increased total capital investment in all, or any, airport categories? Or has it served to substitute federal dollars for investments that would otherwise have been made at the local level?

Before we examine these issues, we must first review briefly the setting and history of federal involvement in the airport construction area.

II. Airports and the Federal Government

The United States has some 12,700 landing areas of which 4,527 have runways between 3,000 and 20,000 feet. Of these, 772 airports are certified for air carrier (i.e., paying passenger) service.[1] Air carrier airports are classified in terms of the number of enplanements per year as large hubs (enplaning over 1% of the nation's total enplanements - over 205,000,000 in 1973); medium hubs (.25-1.0%); small hubs (.05-.25%); and non-hubs (less than .05%). Commuter airports (i.e., those serving commuter air carriers) are now defined as a separate air carrier airport category. In addition there are the general aviation airports (i.e. those serving private planes), and reliever airports (i.e., those able to relieve congestion at an air carrier airport by diverting general aviation activity to the smaller airport). The large hubs account for some 68% of the passenger enplanements.[2] Total passenger enplanements in the U.S. doubled between 1967 and 1977, despite two periods of essentially zero growth, from 1969-1971, and 1973-1975 (Figure 1).

Until recently, the role of the federal government in airport

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[1]U.S. Department of Transportation, National Transportation Report, Washington, D.C., 1974, p. 312. Fewer are regularly served by certificated carriers today.

[2]Ibid.

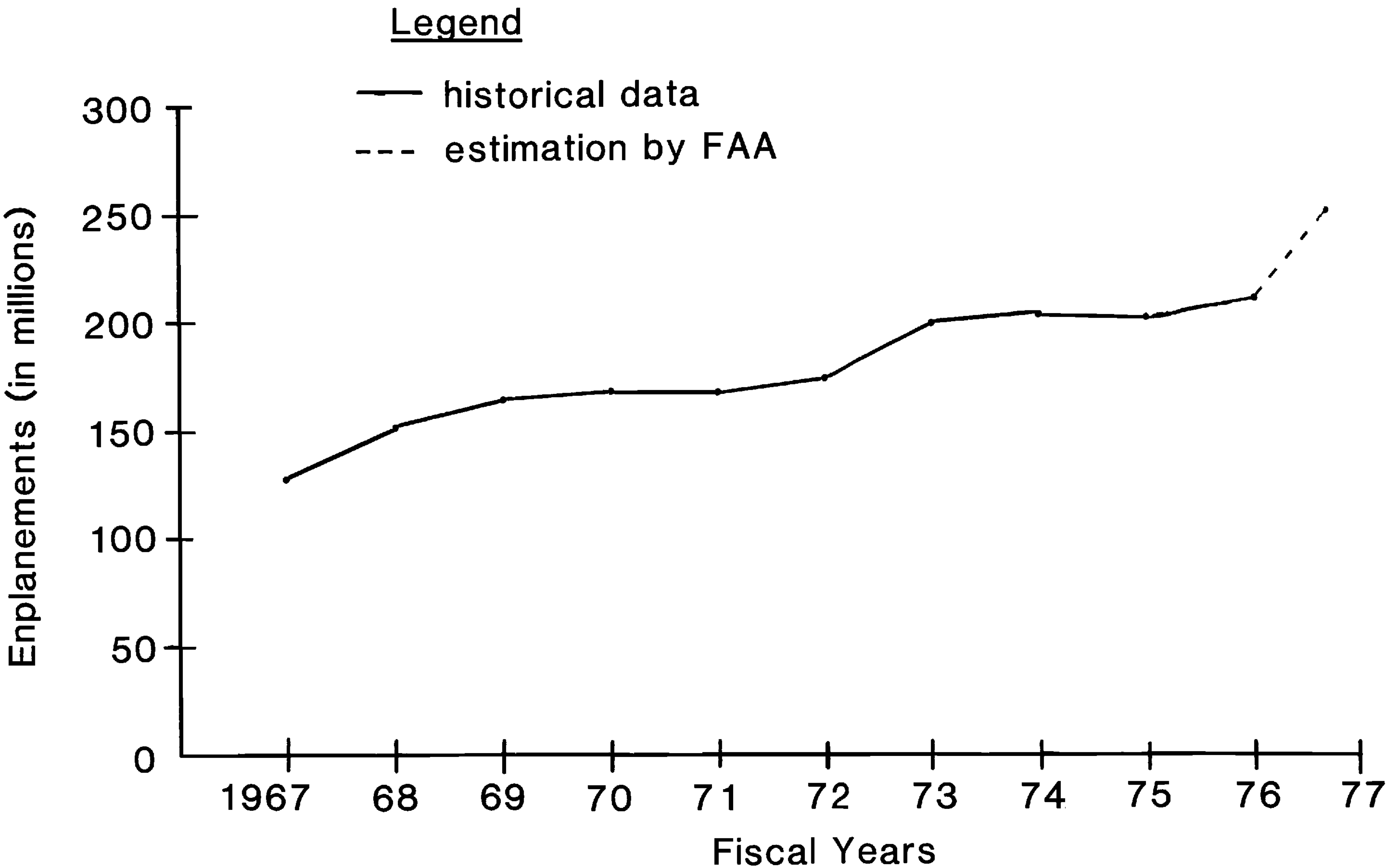

Figure 1: NATIONAL ENPLANEMENT TREND

Source: U.S. Federal Aviation Administration (FAA), Terminal Area Forecasts construction has been quite small.[1] The FAAP program never provided more than $75 million per year, while state and local authorities invested close to $1 billion in 1970, for instance.[2] However, the picture is changing. As shown in Figure 2, ADAP has drastically increased the level of federal involvement. The 1974 National Transportation Report showed anticipated capital investments through 1980 being attributed 25% to federal aid, 46% to airport authority revenues, with the remainder deriving from state, local, user taxes, and private funds, etc.[3] Another estimate placed the federal share of capital investments at about 50%.[4] A sense of the pervasiveness of federal involvement comes from a survey of airport improvement projects in Minnesota from 1963 through 1973. Of 124 such projects, 70 involved federal aid (all through the Federal Aviation Administration - FAA - except for two Economic Development Administration projects); all of the projects involved local funds; 115, state aid as well. In short, the federal government plays a large role in airport capital investments - a role which, as we shall see, has increased sharply in recent years.

III. ADAP

Perceiving a need to stimulate development of the airport and airway system, the Congress passed the Airport and Airway Development Act of 1970 (P.L. 91-258). The Act established:

- a national airport system plan, with airports in the plan eligible

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[1]D. V. Harper, Transportation in America: Users, Carriers, Government Englewood Cliffs, N.J., Spring: Prentice-Hall, 1973, p. 391.

[2]Ibid.

[3]U.S. Department of Transportation, op. cit., Table XII-R-1.

[4]U.S. Department of Transportation, National Transportation Trends and Choices (To the Year 2000), Washington, D.C., January 1977.

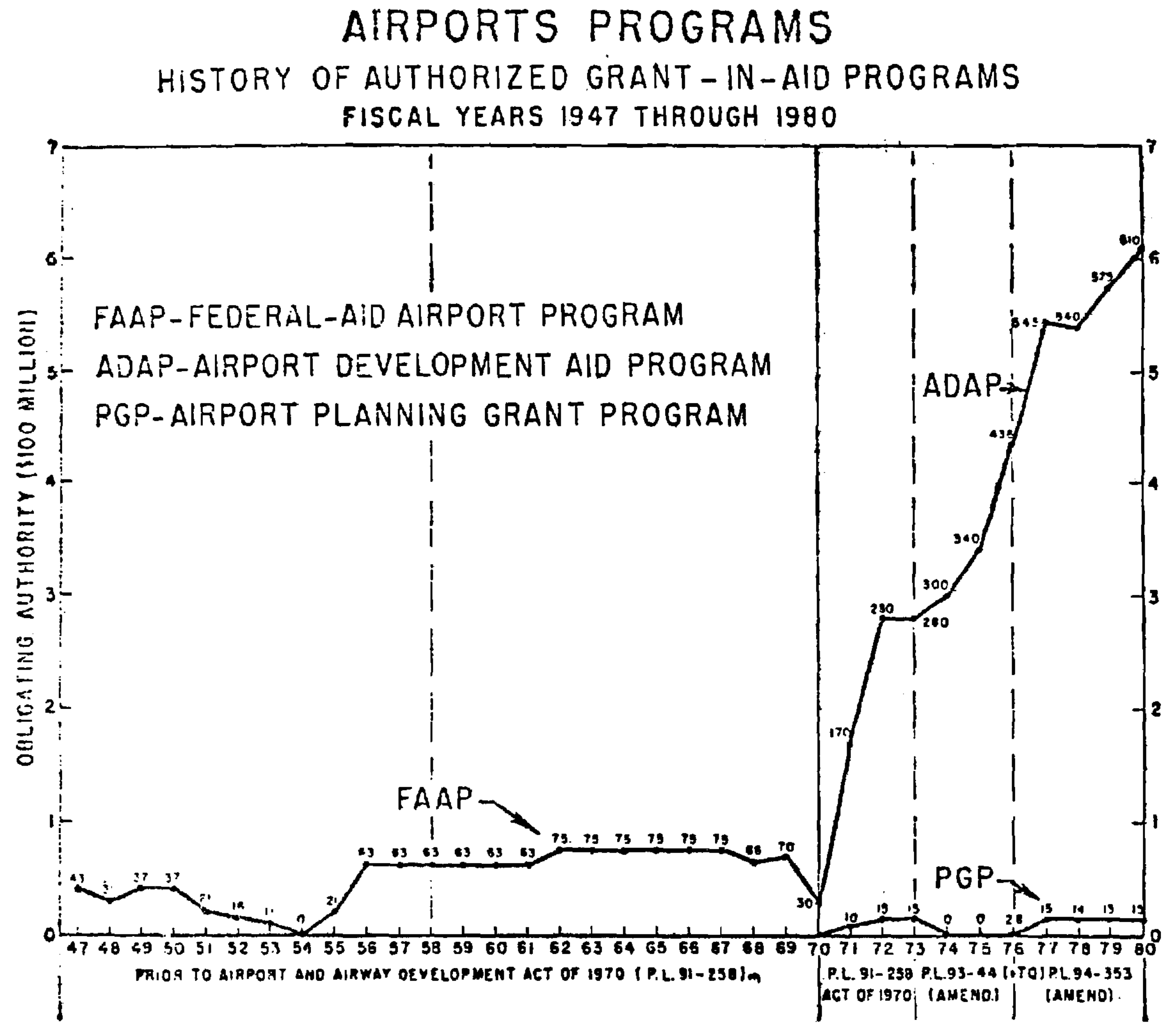

Figure 2. Federal-Aid authorized for Airports

Source: U.S. Federal Aviation Administration, Eighth Annual Report of Operations under the Airport and Airway Development Act, Washington, D.C., 1977.

for federal aid;

- a revised tax structure and an Airport and Airway Trust Fund that dedicated these user revenues for use on airport and airway improvements;
- the Planning Grants Program (PGP) to aid airport planning agencies;
- the Airport Development Aid Program (ADAP).

Establishment of the ADAP program, which provided a four-fold expansion of the federal funds previously available, was motivated largely by a federal interest in relieving congestion at major airports. Indeed, testimony by the FAA administrator predicted 900 new airports would be needed in the 1970's.[1] Explicitly stated goals of ADAP include:[2]

- encourage the development and implementation of airport development programs consistent with national transportation goals and with goals determined locally through areawide planning programs.
- assist investments of airport sponsors in airport facilities.
- improve the safety and economic efficiency of the system by encouraging uniformity in development within appropriate safety and design standards.
- promote the timely development of airport facilities needed to minimize delays due to congestion in the system.
- assure consistency of airport development with other aviation facility installations programmed under the Facilities and Equipment Program for the Federal Aviation Administration.

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[1] J. E. Milch, "Feasible and Prudent Alternatives: Airport Development in the Age of Public Protest," Public Policy 24, Winter 1976, p. 93.

[2] Federal Aviation Administration, 8th Annual Report of Operations Under the Airport and Airway Development Act Washington, D.C., U.S. Department of Transportation, 1977, p. 17.

- assist in the acquisition of non-public-owned airports where communities have committed themselves to public ownership and maintenance of the airport.
- mitigate, to the extent practical, adverse environmental effects of aircraft operations.

Amendments to the Act began right away. In 1971, P.L. 92-174 detailed provisions for the expenditure of funds from the trust fund. More interestingly, P.L. 93-44 in 1973 increased annual authorization for FY1974 and 1975 and increased the federal share for grants at most (but not all) airports. And again in 1976, P.L. 94-353 made a number of major changes, in particular increasing the funding levels and again altering the percentage of the federal contribution for most projects. (The several changes in Federal share are summarized in Table 1.) FAA personnel (personal communication) perceived the main objectives of the 1976 changes to be (1) to reach more sponsors; and (2) to guarantee funding amounts to all air carrier airports. In addition, thanks to strident feedback from potential aid recipients concerning the 105-step grant approval process, there was an attempt to expedite the process and cut red tape.

The focus of this paper is on the changing nature of the funding structures involved in the ADAP program. We have noted the general thrust of the increase in federal funding level (Figure 1), and will have much more to say about the changing federal shares (reflected in Table 1). It is also important to take note of two features of the funding structures: the way in which funds are allocated and the restrictions on their usage. Whereas the old FAAP program was set up on a purely discretionary basis (i.e., each project application was evaluated individually by FAA), ADAP was set up with only one-third of its funds to be allocated on a discretionary basis, with

Table 1. Changes in Federal Share (in percent)

	FAAP	ADAP			
		Period 1	Period 2	Period 3	
	FY 1947-70	FY 1971-73[a]	FY 1974-75[a]	FY 1976-78[b]	FY 1979-80
Large hubs	50	50 →	No change	75 →	No change
Medium hubs	50	50	75 →	No change →	No change
Smaller hubs[c]	50	50	75	90	80
All hubs:					
Landing Aids	50→75 in FY 1967	82	82	Same as project unless otherwise applicable.	
Safety Projects		50	82	Same as project unless otherwise applicable; and established 50% aid for some equipment.[d]	

[a]Matching ratio based on sponsor enplanement.

[b]Matching ratio based on enplanement of the airport undertaking the project.

[c]Includes small hubs, non-hubs, and undesignated.

[d]Equipment necessary for snow removal and noise suppression.

the other two-thirds made available on a formula apportionment basis. The 1976 amendments shifted the air carrier apportionment from one-third on the basis of sponsor enplanements and one-third on a state basis to two-thirds on an airport enplanement basis (i.e., removing the state-based share). A certain amount of the discretionary funds were set aside for use by commuter service airports (previously for reliever airports). As shown in Table 2, general aviation airports have received sizeable federal funds totalling some $337 million, or about 15% of the $2.25 billion granted during FY1971-77. Since FY1974, the dollar amounts going to general aviation airports have remained roughly constant, so that their fraction of the total has declined from about 21% in FY1974 to about 12% in FY1977, as the overall program has grown. Sponsor contribution to these projects is shown in Figure 3; the sharp decline in general aviation sponsor contributions since FY1975 should be noted.

We will concentrate upon the air carrier airports, relegating the general aviation airports to a well-deserved secondary status. While there are doubts about the "national interest" in the Airport Aid Program in general,[1] it is even harder to see significant national interest in the private plane arena. Some would argue that general aviation airports constitute the "grass roots" of the system and they are in the most unfavorable position to finance capital investment, hence federal support is justified. Others note that general aviation airports contribute to the economic welfare, are used by the Postal Service, and, in any event, merit FAA safety provisions. Rather compelling arguments support aid for reliever airports as a cost-effective way to reduce congestion at hub airports. Within the air carrier

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[1]T. P. Messier, "Discussion," Transportation Research Board Special Report 157, Transportation Programming Process, Washington, D.C., National Academy of Sciences, 1975.

Table 2. Capital Improvement Expenditures under ADAP

	FY	1971	1972	1973	1974	1975	1976 +TQ	1977
Federal Funds ($ Million)	ACA	145.3	227.7	172.3	239.2	278.0	373.4	479.3
	GAA	10.3	32.2	36.5	62.0	70.2	59.4	66.0
	Total	155.6	259.9	208.8	301.2	348.2	432.8	545.3
Sponsor Funds ($ Million)	ACA	158.6	204.2	133.7	119.1	145.7	106.6	131.1
	GAA	10.0	31.4	22.8	18.9	23.6	6.6	7.4
	Total	168.6	235.6	156.5	138.0	169.3	113.2	138.5
Total Funds ($ Million)	ACA	303.9	431.9	306.0	358.3	423.7	480.1	610.4
	GAA	20.3	63.7	59.3	80.9	93.8	66.1	73.4
	Total	324.2	495.6	365.3	439.2	517.5	546.2	683.8
Federal/Total	ACA	47.8%	52.7%	56.3%	66.8%	65.6%	77.8%	78.5%
	GAA	50.7%	50.5%	61.6%	76.6%	74.8%	90.0%	89.9%
	Total	48.0%	52.4%	57.2%	68.6%	67.3%	79.2%	79.7%

Note: ACA stands for air carrier airports;
GAA for general aviation airports.

airport classification, we will focus upon the large, medium, and small hubs, as these dominate the passenger enplanement statistics.[1]

Decision making authority for airport investment resides with the airport 'sponsor,' typically a municipality or county, occasionally a local special authority. In addition, a number of states operate airports, but usually these are smaller airports. Privately owned airports are not eligible for ADAP aid. Airport sponsors pay no taxes, and many can issue tax exempt bonds.[2] Commercial airlines generally underwrite bonds floated by airport sponsors for major new construction.[3] This can produce tensions at times. For instance, airlines may prefer to see reliever airports developed (diverting private craft away from a major airport) rather than construction of a brand new major facility. Such preference would be especially strong under fiscal constraints and non-growth conditions such as prevailed in the early 1970's. Airport size (as reflected in passenger enplanements) is a critical factor in sponsors' investment decisions. Both FAA personnel and representatives of the Airport Operators Council International suggested that only the larger airports (the large hubs and the largest ten or so of the medium hubs) can break even financially. So, backed by airline support for a capital investment, a large air carrier airport basically can decide on its own to proceed with a project, treating federal aid as a nice, but

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[1]However, we do appreciate a real "system" character that makes air transportation largely a function of good access to a wide range of places. For instance, as pointed out to us, Pennsylvania has only eight air carrier airports and does not consider only those as constituting the system.

[2]E. J. Feldman, "Air Transportation Infrastructure as a Problem of Public Policy," Policy Studies Journal 6 (1), 1977, p. 21.

[3]Milch, op. cit.

non-critical[1] auxiliary aid. In contrast, the smaller airports essentially cannot pursue construction without significant federal aid. Insofar as airline deregulation weakens the linkage between an airline and a small airport, the ability of such airports to undertake capital improvements may be further weakened.

Against this background, we now turn to the empirical evidence bearing on the effects of changes in federal funding policy, particularly those under ADAP, on actual airport capital improvement expenditures. We consider first the effects of the overall increase in available federal funds, and second, the effects of policy efforts to steer these funds in some directions rather than in others.

IV. Effects of Overall Increase in Federal Funds

The most obvious change in federal funding policy for airport investment is the very large increase in the total funds made available since 1970 under ADAP. Authorized levels were shown earlier in Figure 2; actual grant totals in Table 2. A comparison of the totals shows that actual grants have been close to the authorized totals for all years except FY1973, in which a shortfall due to impoundment may be seen. In current dollars then (Figure 3), the trend has been a steady increase over time in the federal funding used, with a roughly constant (or even declining) total provided by airport sponsors. Total development funds spent on ADAP-

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[1] A similar inference may be drawn from J. A. Neiss, Final Report: Study of the Effect of Head Taxes (The Aerospace Corporation, prepared for Office of Aviation Economics, Federal Aviation Administration, Washington, D.C., 1974, DOT-FA 74WA-3438). His data clearly suggest that only the larger hubs are able to support capital improvements on their own. The share of capital improvement costs borne by federal and state funds increases sharply in his data as one moves from larger to smaller airports.

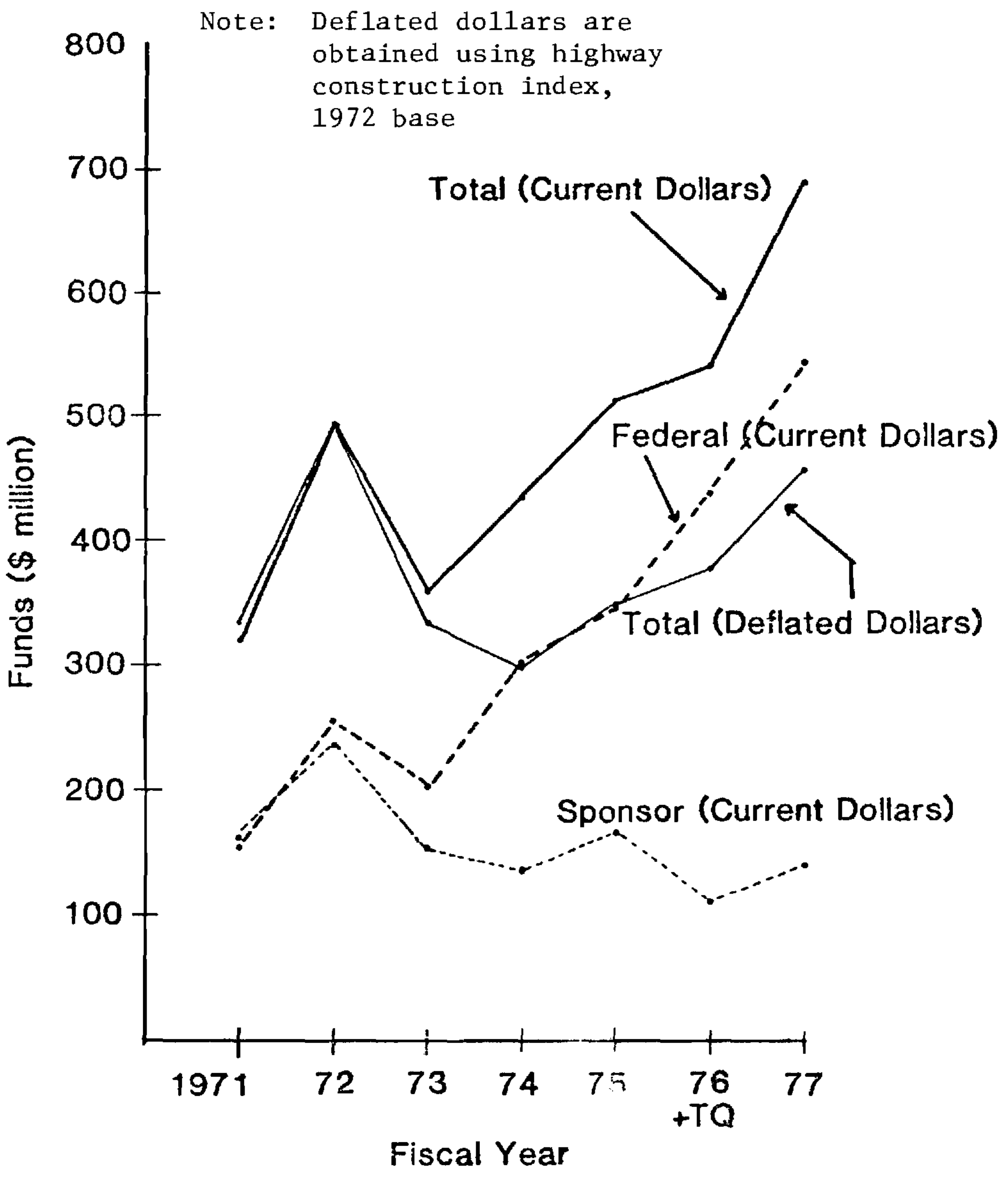

Figure 3. Funds Spent Under ADAP

supported projects have increased, even in deflated dollars. Investments respond to perceived needs, plus increased costs associated with such federal requirements as relocation assistance and environmental protection. (The higher proportion of federal funds might be partly justified as a way to offset some of the costs associated with these federal requirements, rather than an increase in the federal share of actual development.)

We noted earlier that the trend in enplanements over this period has been generally upward, doubling from 1967 to 1977; and that large needs for airport improvement were identified.[1] Under ADAP a large and growing fraction of the necessary capital investment has been provided by federal funds. The strong implication is that a major consequence of ADAP aid has been the <u>substitution</u> of federal for sponsor investment. The effect is not clear in the early years of the program, when the large rise in federal funding from 1971 to 1972 was matched by a similar increase in sponsor funds, and the decline in sponsor investment. From 1973 onwards, however, the pattern becomes quite clear: sponsor investment has stayed roughly constant, federal funds have risen sharply. To the extent that these investments were justified by genuine need, the need has been largely met by the federal government rather than by airport sponsors.

We must add a strong caveat to this conclusion, however. Our data are restricted to the ADAP-aided projects. We do not know what airport sponsors may have invested in non-federally-aided projects. A number of factors enter into this "guess" about the extent of capital investment without any federal aid. Other sources of revenue exist (states, sponsor-issued bonds, airline support through landing fee and terminal rental adjustments). There

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[1] U.S. Department of Transportation, <u>National Transportation Report</u>, Washington, D.C., U.S. Government Printing Office, 1974.

is some advantage in avoiding federal aid because of its red tape delays and more stringent construction standards. Also, much of the investment in the terminal area, such as parking facilities, cargo buildings, and about half of the cost of passenger terminal buildings, is not eligible for federal aid. On the other hand, the availability of discretionary federal funds suggests that one might as well apply when substantial sums are involved. As mentioned, expert opinion agrees that, other than the large hubs and some, or maybe all, of the medium hubs (i.e., 35-65 airports in all), airports cannot afford significant capital investments without aid. Most compellingly, Neiss' detailed financial analysis of selected airports confirms the pattern of little investment without federal aid.[1]

V. Uses of Funds

A. Improvement Versus New Airport Construction

One very clear finding in our analyses is that most of the ADAP funds went to improvement of existing airports, rather than development of new ones. For FY71 through FY77, the share of ADAP funds going to new airports construction averaged 2.4%; the share going to improvement of existing airports never dipped below 96.2% in any one year (Table 3). This flies in the face of the initial claims of hundreds of new airports needed during the 1970's. Dallas-Fort Worth is the only major airport constructed under ADAP.[2] Various reasons can be put forth for this lack of new airport development, including: Section 16 of the 1970 Act mandating public

[1] Neiss, op. cit.

[2] Through FY75, some 1000 airports were improved while 85 new ones (mostly small general aviation) were built according to Federal Aviation Administration, FAA Airports Programs - Developing the National Airport System, Washington, D.C., 1977, p. 2.

hearings,[1] environmental concerns, urban planning issues, and general sluggishness of the airline industry in the early 1970's. Of course, the cost of building a major new airport is enormous - Dallas-Fort Worth shows the largest investment cost, debt, and continuing construction cost in a sample of 17 large hubs.[2] Most of the new airports included in the National Airport System Plan were small general aviation facilities that were not built for reasons including a lack of local sponsorship and a shortage of ADAP funds for such airports. Nonetheless, the data clearly contradict the rhetoric, if not the actual expectation, of the ADAP legislation: it has proved in practice to be a program for airport improvement, not for new airport construction.

Table 3. Total Funds Used for Improvement of Existing Airports and New Airport Construction (in percent)

FY	1971	1972	1973	1974	1975	1976+TQ	1977
Improvement	98.2	96.8	96.2	97.4	97.6	98.3	98.7
New Airport	1.8	3.2	3.8	2.6	2.4	1.7	1.3

B. Categories of Use, and Categories of Users

A breakdown of average annual investment by use category and hub type is shown in Table 4 for the three phases of ADAP legislation. In current dollars, total investment has steadily increased over time. For period 1 (FY1971-73), average annual investment ran a little under $400 million per year. During Period 2 (FY1974-75), the rate was some 21% higher (around

[1] Milch, op. cit.

[2] J. A. Neiss, "Terminal Economics & Financing," Airports International, October/November 1975.

Table 4: Average Total Investment per Year by Hub Type and Expenditure Category

		Average Annual Investment ($ Million)						GROWTH RATE[a]	
Expense Category	Hub Type	Period 1 FY 1971-73	%[b]	Period 2 FY 1974-75	%[b]	Period 3 FY 1976-77	%[b]	Periods 1-2	Periods 2-3
Landing Area Construction	Large	71.25	41	65.55	39	69.56	35	-8%	6%
	Medium	29.42	39	32.92	40	48.76	37	12%	48%
	Other	77.27	53	113.06	50	151.46	53	46%	34%
	Total	177.94	45	211.53	44	269.78	44	19%	28%
Other Land	Large	43.05	25	30.48	18	28.88	15	-29%	-5%
	Medium	23.77	32	14.25	18	18.89	14	-40%	33%
	Other	21.66	15	25.38	11	33.00	12	17%	32%
	Total	88.48	22	70.11	15	81.37	13	-21%	16%
Site Preparation	Large	14.56	8	26.01	15	18.41	9	79%	-29%
	Medium	11.51	15	10.86	13	19.18	14	-12%	90%
	Other	22.83	16	34.87	15	35.31	12	53%	1%
	Total	48.90	12	71.74	15	72.90	12	47%	2%
Landing Aids	Large	8.99	5	7.13	4	11.51	6	-21%	61%
	Medium	3.59	5	7.01	9	8.70	7	95%	24%
	Other	9.52	7	18.02	8	21.27	8	89%	18%
	Total	22.10	6	32.16	7	41.48	7	46%	29%
Building	Large	0.56	0	5.18	3	0.72	0	820%	-86%
	Medium	0.85	1	0.81	1	1.86	1	-4%	130%
	Other	2.44	2	7.53	3	6.19	2	209%	-18%
	Total	3.85	1	13.52	3	8.77	1	251%	-35%
Other	Large	36.58	21	35.04	21	68.56	35	-4%	96%
	Medium	6.17	8	15.56	19	35.18	27	152%	126%
	Other	11.01	8	28.71	13	36.91	13	161%	29%
	Total	53.76	16	79.31	17	140.65	21	48%	77%
All Categories	Large	174.99	44	169.39	35	197.64	32	-3%	17%
	Medium	75.31	19	81.41	17	132.57	22	8%	63%
	Other	144.73	37	227.57	48	284.74	46	57%	25%
	Total	395.03	100	478.37	100	614.95	100	21%	29%

[a] $\frac{\$/\text{year in period } (i+1) - \$/\text{year in period } (i)}{\$/\text{year in period } i} * 100$, for i = 1, 2.

[b] % of appropriate column sum (e.g., 71.25 is 41% of 174.99).

$480 million annually), while in Period 3 (FY1976-77, part of FY78), it averaged about $615 million, a further growth of 29% over Period 2. As noted earlier, however, the effects of inflation have been sufficient to keep these rates roughly constant in real dollar terms.

A surprising proportion of these funds have been invested in smaller airports - those designated as 'small hubs,' or 'non-hubs,' or not designated. In Period 1, these airports accounted for over one-third of all investment, a figure close to one-half in Periods 2 and 3. Given the highly skewed distribution of enplanements across airports, with a very few large airports accounting for a huge percentage of enplanements, this represents a relatively much larger investment per passenger enplaned in small airports than in large ones.[1] We shall return to this point in more detail later in the paper.

For all categories of airport, the largest single expense category is Landing Area Construction, which accounts for close to one-half of overall annual investment. When Landing Area Construction is added to two other expenditure categories - Other Land, and Site Preparation - roughly three-quarters of all investment funds are accounted for. The remaining monies go to Landing Aids (approach aids, land for lighting systems, and airport lighting), running around 6% of the total budget; Building (around 1-3% of the total); and a significant category here labeled "Other," which includes relocation costs, safety and security equipment, and other costs, and, in Period 3, environmental land. This last category has grown with time for all hubs between Periods 1 and 3 (from 21% to 35% for large hubs, from 8% to 27% for medium hubs, and from 8% to 13% for smaller hubs).

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[1]We do not address the related consideration of freight transport.

The data in Table 4 provide some indication of the extent to which airport capital expenditure is sensitive to changes in the matching ratio. Referring back to Table 1, we recall that for large hubs, the federal share of improvement costs moved from 50% (periods 1 and 2) to 75% (Period 3). Total investment in large hubs increased in Period 3, from $169.4m annually to $197.6m annually, a 17% jump. The boost in federal share of safety projects between Periods 1 and 2 (from 50% to 82%) should be reflected in an increase in the "Other" category for all airport types. The data do, indeed, show such an increase in expenditures in this category of 48% from Period 1 to 2 - but they show an even larger increase, of 77%, between Periods 2 and 3, when no change in matching ratio occurred. The shift in matching ratio for medium hubs between Periods 1 and 2 (from 50% to 75%) is not reflected in any large increase in total expenditures: they grew only 8% in this period, as against a 63% growth from Periods 2 to 3, when there was no overall change in matching ratio for medium hubs.

In short the evidence, in this crude breakdown, that matching ratio has a direct effect on expenditure is mixed. In some cases, such a connection can be argued, in others there is no evidence, and in some cases the evidence is negative. We are attempting to tease out this relationship with other, more sophisticated, analyses, the results of which will be reported elsewhere. For the moment, however, we conclude that there is certainly no clear, unambiguous linkage. Increase in federal matching ratio may, in some cases, influence the expenditure category to which it is aimed. In other cases, it may not. The present data argue strongly against any assumption that this particular policy lever operates powerfully, directly, and in every case. Indeed, there is no compelling evidence here that it works in a consistent manner.

A parallel breakdown of expenditures by category for Air Carrier versus General Aviation Airports is shown in Table 5. Bearing in mind that General Aviation Airports tend to be quite small, the distribution of funds largely parallels that shown in Table 3. Perhaps the sharpest difference between these two classes of airport is seen in the "Other" category (which includes safety equipment, amongst other things). General Aviation Airports typically obtain less than half the percentage of funds that Air Carrier Airports do in this area.

C. Investments Versus Enplanements

We noted earlier some indication that relatively larger investments have been made by smaller airports than by larger ones. This suspicion is sharply reinforced by the data in Table 6, which show (in constant dollars) the average federal, sponsor, and total investment per passenger enplaned at large, medium, and small hubs across the three periods of ADAP funding.

The data here are quite clear. Comparing Period 1 with Period 3, total expenditure per passenger has declined at large hubs, primarily as a result of falling sponsor investments - federal investment has remained roughly constant in deflated dollars. For medium hubs, total investment per passenger has remained roughly constant, with sponsors contributing less, and federal funds contributing more. For small hubs, total funds per passenger have increased, despite a sharp decline in sponsor investment; the balance has been made up by a huge growth in federal funds. Comparing large to small hubs, the latter consumed about twice as many dollars per passenger in Period 1; by Period 3, this figure was close to four times as much. The federal share of this expanded from about 2:1 in Period 1 to about 5:1 in Period 3.

Table 5. Fund Distribution by Activity Category (as Percent of Period Total by Airport Type)

	Period 1 (FY 1971-73)		Period 2 (FY 1974-75)		Period 3 (FY 1976-77)	
	ACA	GAA	ACA	GAA	ACA	GAA
Landing Area Construction	45.7%	40.2%	44.5%	42.9%	43.4%	47.4%
Other Land [a]	22.0%	25.3%	13.1%	21.6%	12.0%	23.2%
Site Preparation	11.6%	17.7%	14.3%	17.8%	11.7%	12.8%
Landing Aids [b]	5.2%	8.5%	6.0%	10.2%	6.5%	4.2%
Building	1.0%	0.8%	3.3%	0.5%	1.5%	0.5%
Other [c]	14.5%	7.5%	18.8%	7.2%	24.9%	11.9%
Total	100 %	100 %	100 %	100 %	100 %	100 %

[a] FAA category of "other land," excludes approach lighting system land.

[b] Sum of approach lighting system land, airport lighting, and approach aids.

[c] Includes relocation, safety and security equipment, environmental land (in Period 3), and other costs.

Note: Same as Table 2.

TABLE 6 - FUNDS USED PER ENPLANEMENT
(IN CONSTANT DOLLARS)[a]

	Period	Mean of annual funds per enplanement (in 1,000) per airport			t-values[b]			
		Period 1	Period 2	Period 3	Period 1-2	Period 2-3	Period 1-3	Number of Airports
Total funds	Large hubs	1,302	1,028	885	-1.747+	-0.939	-2.537*	20
	Medium hubs	1,920	1,267	1,840	-2.034+	1.863+	-0.278	30
	Small hubs	2,514	2,193	3,463	-0.676	3.464*	2.079*	71
Sponsor funds	Large hubs	656	517	277	-1.746+	-3.098*	-4.521*	20
	Medium hubs	908	300	445	-4.733*	2.011+	-3.727*	30
	Small hubs	1,180	532	417	-3.229*	-1.852+	-3.967*	71
Federal funds	Large hubs	646	512	608	-1.649	1.158	-0.441	20
	Medium hubs	1,012	966	1,394	-0.217	1.796+	2.121*	30
	Small hubs	1,334	1,660	3,045	1.126	4.497*	5.521*	71

[a]Deflated using the highway construction index (1972 base).

[b]Used paired t-tests to assess statistical significance.

[c]Only airports which remained in the same category for all three periods are included in this tabulation.

*Indicates that change between the two phases is significantly different from zero at $\alpha = 0.05$ (two-sided test).

+Indicates that change between the two phases is significantly different from zero at $\alpha = 0.10$ (tow-sided test).

In short, under ADAP, small hubs have increased their investment per passenger enplaned, while significantly reducing their own contribution to the process. Where in Period 1 the relatively higher cost per passenger at small hubs (about twice that of large hubs) was evenly borne by sponsor and federal funds, the ratio has now expanded to four to one, with the load falling almost entirely on the federal government. Given the relatively tiny fraction of the total passenger load carried by these small hubs, we question the large capital improvements expense at them, particularly when this extra cost is virtually all borne by the federal government. Of course, the federal ADAP expenditures distribute user tax revenues, not general treasury funds. Hence, the issue boils down to the extent that aviation system users should subsidize the users of the smaller facilities that are higher cost per enplanement. Some such subsidy appears warranted to maintain a viable, safe large-scale air transportation system, but the issue is how much, for what sorts of improvements.

VI. Concluding Observations

Our analysis has been on the expenditure of ADAP funds; we now briefly consider the source of those funds. We have noted that the source of these funds is a user tax. The user taxes going into the Trust Fund include an aviation fuel tax (7¢/gal.), a passenger ticket tax (8%), an international passenger travel fee ($3), an airfreight tax (5% on waybills), tire and tube taxes, and an annual aircraft registration tax ($25 plus 2¢/lb. for piston craft over 2,500 lbs. and 3.5¢/lb. for turbine craft). A concern noted in the original act that has continued to this day is the allocation of aviation system costs to the various users (air carrier, general aviation, government) and equitable recovery of those costs. A 1973 study concluded that costs of the Federal Airport and Airway System should be allocated 50% to air carriers, 30% to general aviation, and 20% to the public sector to support military and government flying.[1] The largest inequity was found to lie in the general aviation sector - found to be paying only 20% of their share (through user taxes). It should also be noted that while airport development (ADAP) funds derive from trust fund user fees, the preponderance of federal expenditures to operate and maintain the system derive from general funds (i.e., FAA operation of the airway system and such other expenses as maintenance of the D.C. airports). Indeed, only 32.1% of federal aviation expenditures projected for FY77-80 were from the Trust Fund; 67.9% were from the General Fund.[2] These considerations raise two concerns: the subsidy by the public at large of the general aviation sector, and the subsidy by air carrier users of air carrier and general aviation services to small communities.

A. Implications of the Analysis

As we turn to consider the overall implications of airport funding strategies, we would like to draw upon findings reached in our broader study. In brief, sensible evaluation of any funding strategy must be made on the basis of the programmatic funding intent. By this we do not mean only the substantive intent of the program (e.g., to provide safe, economical, and rapid intercity transportation), but rather the reason for federal involvement in funding the program. We distinguish four basic intents for such funding:

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[1] U.S. Department of Transportation, Airport and Airway Cost Allocation Study, Part I, Washington, D.C., September 1973 (a new study has recently been completed).

[2] U.S. Department of Transportation, National Transportation Trends and Choices (To the Year 2000), Washington, D.C., January 1977.

1) national interest in promoting the program (e.g., the Interstate Highway System);
2) regional development aims (e.g., the Appalachian Development Highway System intended to promote economic development);
3) "stimulation" of the recipient government to expend more of its own money than it would otherwise do;
4) "subsidy" of the recipient in a program of local interest, where recipient fiscal means are limited.

Different programmatic funding intents suggest different funding strategies. For instance, a program of true national interest may well warrant a high federal share in a tightly categorical program. If one's aim is to stimulate recipient investment, one again would use a categorical program, but one with a low federal share to maximize leverage on the recipient's investment. On the other hand, if the intent is basically to subsidize recipient transportation efforts, a more flexible block grant program would seem to be in order.

A separate reason to involve the federal government in airport funding is to provide an equitable mechanism by which users can aid in financing the development of the system. However, we differentiate this from the four funding intents by noting that this pertains to revenue collection. If one wanted the federal government to be involved solely as collection agent, several avenues other than federally funded development programs exist to distribute the funds collected. For instance, one option would be return of the funds to airports on the basis of amounts attributable to them, with no programmatic strings attached. Other options might involve different redistributions (e.g., to subsidize smaller airports).

Against this background, let us summarize the major findings presented here. Under ADAP, there has certainly been a significant increase in airport investment, an investment that was most likely a response to genuine need. Despite the rhetoric about need for new airports, few have appeared; ADAP has been almost entirely an airport improvement, not a new airport, program.

With the large growth in federal input, and a constant or declining airport sponsor contribution, airport improvement in this country has moved from a 50/50 split between sponsors' and federal funds to more of an 80/20 split (90/10 for General Aviation Airports for Period 3) with the federal government providing the lion's share. There is some evidence that this large federal investment may have shifted construction quality in the direction of improvements in safety equipment. There is little evidence that the manipulation of matching ratio has induced strong or consistent changes (other than increased federal share). In contrast to highways, the increase in federal share does not seem to "free up" sponsor funds that then get invested in other capital improvements.

Finally, there has, under ADAP, been a sharp growth in capital costs per passenger enplanement at small airports, with the federal share accelerating still more rapidly as the sponsor share has declined. We are left with a picture that ADAP has clearly promoted airport development as a whole. If it is, indeed, a program of direct national interest, increasing outlay and federal share of same are appropriate. Another plausible interpretation is that ADAP mainly amounts to fiscal relief; if that is the intent, ADAP is on target. ADAP may well have "stimulated" sponsor investment in certain categories (e.g., safety-related), but it does not appear to have led to increased total sponsor investments. As long as "stimulation" of that sort is not a major intent of federal funding (and we see no justification that it is), ADAP appears to be performing appropriately.

This leads us to underline the question of national interest in airport development. It is clear that the airway system is of national interest. One might argue that certain categories of airport investment, such as required safety equipment, development aimed at providing uniformity of facilities, and capacity development, fall within this national purview. The rationale of a "national" airport system is less compelling. Again, it is hard to judge the success of ADAP's air carrier airport development inducements when the intended pattern is not clearly set forth. If the intent was to establish "hundreds" of new airports, clearly ADAP has not succeeded. If the intent was to divert the concentration of air carrier traffic from the largest hubs to smaller air carrier airports, the jury is still out. It will simply take time to see the effects of any enhanced development at the smaller hubs, complicated by interactions in airline routing patterns largely determined by airline decisions and CAB regulations. The recent movement toward CAB deregulation appears to have boosted enplanements, but also promises to alter the distribution of passengers among the airports. It is not clear how this fits with ADAP and a national interest in airports. A strategic alternative to increased airport capital investment would be to make better use of existing capacity.[1] If one wants to raise this set of national interest concerns further, the whole general aviation airport support program can be called into serious

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[1] U.S. Department of Transportation, National Transportation Report, Washington, D.C., U.S. Department of Transportation, 1974, p. 417.

question.[1]

Two general conclusions seem well-supported. The first is that in the absence of strong reasons otherwise, federal aid programs should be as flexible as possible. This suggests that one would prefer block grant programs to set categorical programs, in the absence of a good rationale. One might even prefer to leave the funding entirely to lower governmental levels that have the interest and capability to accomplish it. This also suggests discretionary rather than formula programs. However, formula programs have an advantage in being easier to administer, typically implying less programming delay, and less vulnerability to potential political influence (of course, noting that setting an apportionment and allocation formula is political too). If one prefers a formula program, allowing an airport sponsor to carry over obligational authority over several years is advantageous in providing the flexibility to plan for larger expenditure items.

The second, and closely related, principle would be to minimally distort recipient investment decisions. In particular, very high federal matching shares make almost any investment under those terms appear advantageous. For ten cents on the dollar (or even less, if one takes into account state matches as well and higher federal shares in Public Land states), any airport construction project might be deemed desirable just in

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[1]This is based upon logical consideration of funding intents, not empirical examination of the performance of general aviation airport performance. It is interesting to note that Administration proposals in 1975 favored leaving general aviation airport financing to the states and airport owners (it was not approved) (see Federal Aviation Administration, Op. Cit., p. 3). In addition, the 1976 Act provided for a demonstration project to determine how effectively states could take over the general aviation program. Results were encouraging, but not conclusive (see Federal Aviation Administration, State Demonstration Program for General Aviation Airport Development, Washington, D.C., June 1978).

terms of providing employment and other secondary benefits. As another example, high federal shares for capital investments are an inducement to sponsors to forego maintenance and simply come back at an early date for a "construction" project such as a runway overlay. This is particularly true when the annual cost of maintaining a facility exceeds the amortized annual cost of financing the local share of developing it. Any program with high percentages of federal aid could entice sponsors to develop facilities that they may not be able to afford to operate and maintain. In essence then, the principle would appear to be to minimize influence on state and local investment decisions assuming that those parties best know their own needs (again, unless there is a clear national interest in a particular program area). All in all, the ADAP program does not stack up too badly on these counts. As a final recommendation, any attempt to reformulate the ADAP funding structures ought to begin with a careful consideration of the national interests involved in airports.

B. Some Observations on 1980 Legislative Proposals

Debate on the provisions of the 1980 airport legislation promises to be interesting. The ADAP legislation expires at the end of June, 1980 and requires renewal of both expenditure authorizations and taxing provisions. An Administration proposal (Senate bills S. 1581 and 1582, also House bill HR 3745) basically maintains the structuring of the ADAP program, increases funding level, enhances the state role, and opens Trust Funds for some maintenance and operations uses. More intriguing, a proposal by Senator Cannon (S. 1648 and S. 1649) would remove the large and medium hubs from the ADAP program while reducing the passenger user tax from 8% to 2%. It would draw down the Trust Fund surplus (in the $3 billion range) to fund the remaining ADAP program at an effectively increased level. It would provide greater flexibility in funding from a large discretionary fund for all categories of airports together (with 5-year minimum amounts to reliever, general aviation, and air carrier airports). The philosophy is to "defederalize" development of the major hubs and increase aid for the smaller airports. It is expected to result in increased development at the large and medium hubs due to reduced red tape and an actual increase in available funds (over 90% of the capital improvement investments are supported by airport charges for landing fees and such; reducing ticket taxes and ADAP allows airlines to increase the amount contributed more efficiently and directly to airport facility improvements - and to guarantee more bonds).[1]

Drawing upon our analyses, we offer a few comments on the proposals. Our starting point is to inquire about the national stake in ADAP. We agree with Senator Cannon's argument that if the large airports can manage (better) without federal funding, they should be allowed to do. This is consistent with our stance that decision-making is best handled at the lowest sensible governmental level, with the fewest economic distortions and constraints. Likewise, we concur with the notion of greater discretion for FAA to determine worthy projects with less constraint as to amounts allocated to various types of facilities. We raise a concern over the appropriate amount of subsidy to be provided by aviation users and by the general public to the smaller airports. Distinctions between general aviation airports and air carrier or reliever airports seem desirable. Establishment of fair user contributions is an important issue deserving

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[1] Statement of Paul R. Ignatius, Air Transportation Association of America before the Aviation Subcommittee, Commerce, Science and Transportation Committee, U.S. Senate, September 10, 1979.

consideration, but one largely beyond our scope. Insofar as remaining ADAP funding would be intended largely to relieve the financial burden on the smaller airports, we feel that a high federal aid share with minimal strings attached is best.

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