

A RETURN ON INVESTMENT ANALYSIS OF
VIRGINIA'S INTERSTATE SYSTEM

by

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

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I. SUMMARY OF FINDINGS

Major Findings

Construction of the Interstate System in Virginia has served as a catalyst to:

1. Create 22,705 more manufacturing jobs during the period 1961-1968.
2. Contribute 69,475 more employment opportunities in the non-manufacturing sector.
3. Generate \$2,471,266,000^{1/} in additional personal income as a result of increased manufacturing and non-manufacturing employment.
4. Stimulate private capital investments of \$2,830,784,000 during the period between 1964-1968.
5. Generate \$183,833,300 more real estate taxes to the communities having interstate highways.
6. Result in \$52,167,000 more state income taxes paid to the Commonwealth of Virginia for the period 1961-1968.
7. Generate sufficient income expansion to contribute to the general economy of Virginia an amount equal to the total highway investment plus 6% interest compounded annually in a period of eight and one-half years.

Additional Observations

1. There are indications that the construction of the interstate system has contributed to full employment, which is one of the national economic goals.
2. The total cost of construction and maintenance of the interstate system in the period 1961-1968 was \$1,278,362,900, which leaves an estimated annual return on investment of 11.66%.
3. Temporary losses can be expected in some instances.
4. This study has measured net effects but it was not possible to estimate the dollar losses to small businesses that were temporarily hurt or permanently disabled.

^{1/} This figure has been adjusted for time value.

II. INTRODUCTION

A. Objectives of the Study

The superior design of the interstate system has resulted in the saving of approximately 495 lives in Virginia during the past nine years. Virginia will have approximately 1,053 miles of interstate routes when the system is completed; and the Department of Highways estimates that this system will save 200 lives annually when all of it is open to traffic. However, this study was initiated to enable the Virginia Department of Highways to answer the increasing number of requests for information on the state-wide economic impact of the Interstate Highway System in Virginia.

Over the last ten to twelve years, the Bureau of Public Roads, in individual states, has conducted economic impact studies (also called bypass studies) dealing with isolated segments of new and existing thoroughfares. Some of these were one year studies, while others were conducted over a five or ten year period. In fact, so many of the impact studies were made that some persons believed the subject to have been exhausted. Recent requests in Virginia, however, tend to suggest that while previous studies have been useful they have left some questions unanswered. Specifically, these questions include:

- (a) What has the total impact been on the state as a whole? and
- (b) How much tax revenue has been generated in an individual county or city as a result of increased and/or expanded commercial development?

B. Literature Search

A preliminary review of the literature disclosed that questions of this nature could not be answered by synthesizing previous studies. There are many reasons for the insufficiency of this information. For example there are no impact studies for all areas of the state. While numerous impact or bypass studies were conducted by the Department, not all areas having the interstate system were covered nor were any studies conducted in those areas of the state not receiving interstate highways. The effects or impact will take longer to materialize in some areas than in others; for example, the impact on an urban area might be substantially different from that on a rural community. If the gaps of missing information were to be filled, that is, if complete studies were to be made for those areas which were omitted and the previously conducted studies updated, this would be a time consuming and very costly operation. Therefore, as a result of a preliminary investigation it was de-

cided that the most logical approach would be to conduct an entirely new study utilizing a substantially different methodology.

Specifically, the purpose of this study was to develop and test a methodology for estimating the return on investment and other measures of economic impact of highway expenditures. The aim was to develop a procedure which would be both economical and less time consuming than previous impact or bypass studies. Yet, while simplicity was desired the researcher wanted to retain as much accuracy as possible. In the preliminary review of the literature it was indicated that four basic approaches have been used in most of the previous studies. Succinctly, these are the comparison of the survey control area, the relationship of projected land use values, the case study method, and multiple regression analysis.^{2/}

C. Why A Return on Investment Analysis of Highways?

In the literature search, it could not be determined that any other state had viewed the impact of a highway system from the return on investment viewpoint. Most of the studies were viewed from a benefit cost standpoint or from the impact in a small area (i. e. the impact of a bypass on the businesses and property values of a community).

Why was the return on investment technique selected? The reason actually is in the difference in the definition of the two terms "benefit cost ratio" and "return on investment."

Benefit Cost Ratio — When one uses the benefit cost ratio approach for public expenditures one does not think in terms of income expansion, but rather generally views the impact from the viewpoint of the estimated benefits to the user. In this case the user is paying all or most of the cost.

Return on Investment — On the other hand, the return on investment approach to public expenditures examines an investment from the viewpoint of income expansion, which benefits not only the user, who in the case of highways has or is paying the cost, but actually generates private investments and income expansion that enable the state^{3/}

^{2/} McGough, B. C. "Methodology for Highway Impact Studies," The Appraisal Journal, Published by American Institute of Real Estate Appraisers, January 1968, pp. 65-72.

^{3/} State as used here means the entire state government and not just the Highway Department.

to recover its investment through additional income that may be used for other purposes (education, safety, welfare, or the expansion of other needed services).

This study dealt with the return on investment approach, or how fast does the state and/or community recover the highway users' investment in highways through newly generated income and private investments.

Therefore, from the above explanation it can be seen that benefits also accrue to those who do not contribute to the specific taxes that pay for the improvements (in this case highways), nor to those who are not tax payers to the area (the nation, the traveling public, etc.). Another group receiving benefits, one cited by George A. Taylor in his book entitled Managerial and Engineering Economy, Economic Decision Making,^{4/} are those "... who are not paying taxes in any proportion to the benefits received."

Mr. Taylor also explains why it is logical to view public expenditures such as those for highways from a return on investment approach rather than from the cost benefit ratio viewpoint. For example:

"This is both the nature of public enterprise in this country as well as a statement of its philosophy. This philosophy holds that the benefits must not be limited to those who can pay, and further holds that, by extending these benefits to those who cannot pay, society at large will maximize its total benefits."^{5/}

Highways, by their very nature (sometimes distinct from their method of funding), benefit not only the user but the non-user as well. For example, a bridge or toll road between two cities, which is operated solely from tolls, will benefit not only the highway user but the merchants in both communities, since it might expand the communities' trading area.

In addition a return on investment analysis of highway expenditures, or any other public expenditures, offers the public administrator the advantage of assigning priorities to projects on the basis of the rate of return.

^{4/} Taylor, George A. , Managerial and Engineering Economy, Economic Decision Making, D. Van Nostrand Company, Inc. , Princeton, N. J. , 1964.

^{5/} Ibid. p. 391

D. Organization of Report

In addition to the summary of findings and the introduction, this report is divided into five sections as follows:

- Methodology provides a detailed description of the methodology used and the assumptions made in this study.
- Selection of indicators — This section enumerates the individual variables selected as being significant and gives an explanation of why they were chosen.
- Cost of the interstate — Explanation of construction and maintenance costs of the interstate system.
- Return on investment analysis — Discusses some of the various methods available and computes the estimated return on investment.
- Appendices — Include supporting documents and tables the author considered pertinent to this report.

III. METHODOLOGY

As explained earlier in this report, preliminary analysis indicated that the methodology used in the usual impact study would not provide the answers desired by the Department. Additionally, it is recognized that it was necessary to deal with the county as a whole in an attempt to measure net benefits of governmental and private investment as well as income expansion associated with highway development. It was the researcher's opinion that in order to provide a true picture of the net impact on an area it was necessary to view as nearly as possible the entire economy of the community. There was one exception to this philosophy, however; that was the desire of the author to evaluate real estate market values of properties adjacent to and within a mile of the interstate system. However, in attempting to collect these data several problems were encountered. In addition to the fact that this data collection process was time consuming and costly, the author also discovered that records were not maintained in a uniform manner in all courthouses; nor was it possible to trace all of the individual parcels involved back to a date prior to the opening of the highway. After some months this approach was abandoned in favor of the use of secondary source data.^{6/}

In lieu of collecting the data directly from the tax roles of the individual municipalities the research selected data collected on a county wide or municipality wide basis by the Department of Taxation. This information is published regularly in the Department of Taxation's Annual Report to the Governor of Virginia. A preliminary examination made after consultation with the Research Section of the Department of Taxation revealed that these data would yield the information that would provide an estimate of the net impact on the community. A more detailed explanation of the use of these data will be covered in Section IV entitled "Selection of Indicators."

A. Definition of Study Area

Since it was impossible to construct the interstate system in all communities at one point in time, for analyses it was necessary to divide the state into "study areas" that would approximate the completion date of the stages of development of the interstate network.

^{6/} Secondary source data is defined as that data collected by another organization for its own use or for the convenience of the public.

Primary source data would be that data collected for a specific purpose such as the researcher's examining courthouse records to trace the market value of the real estate parcels described above.

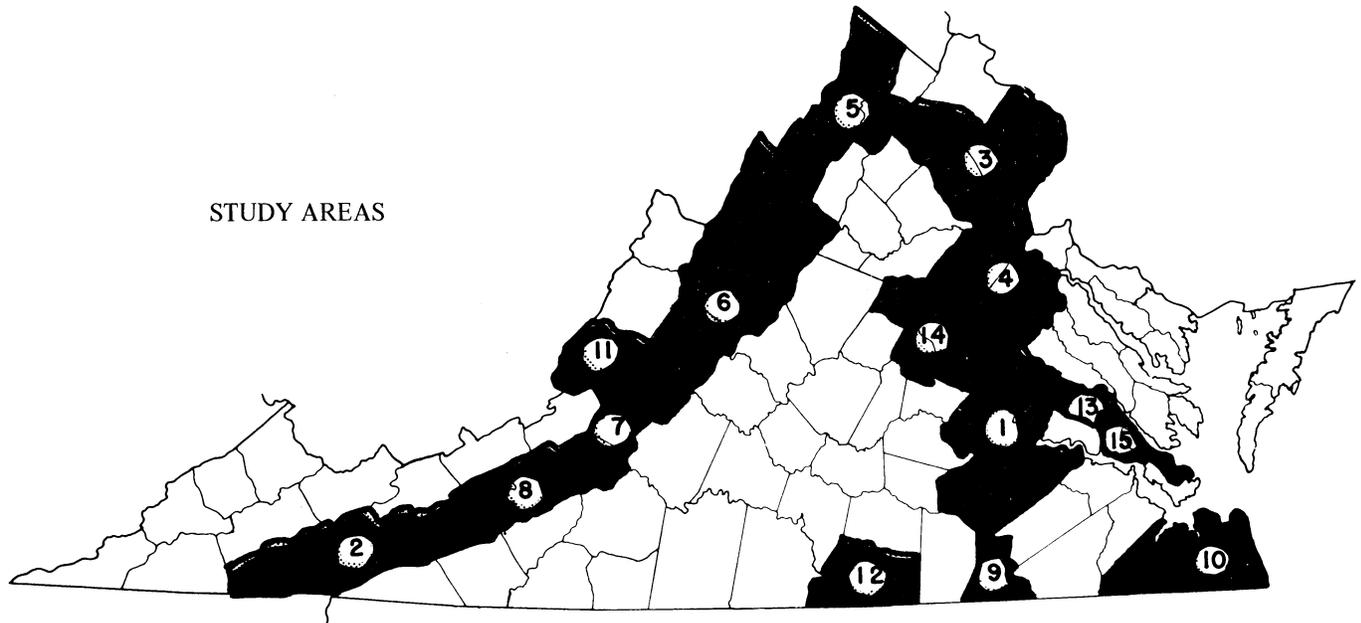
In establishing the study areas consideration was given to commuting patterns, labor market areas, and trading areas. In other words, the areas were selected not only from a standpoint of continuity of the construction of the highway but also economic considerations such as the interchange of labor supply, retail sales, and trading areas which would make the individual counties or municipalities dependent upon one another. The study areas used in the study are shown in Figure 1, which indicates the individual municipalities included within the study area and the date of the opening of the interstate system. All parts of the state which have an interstate highway open to traffic are included in these study areas.

B. Establishment of Bench Marks

In order to measure the benefits of any highway program it is of course necessary to establish the rate of economic growth prior to the opening of the facility. For the purposes of this study the bench marks were established in 1950 for all of the indicators with the exception of retail sales, bank deposits, and real estate assessments. In the case of retail sales the bench mark period was 1954, that for real estate assessments was 1956, and for bank deposits it was 1958, since 1950 data were not available.

After the bench marks were established, all available secondary source data for the selected indicators were analyzed in order to establish the points necessary for making projections. With the exception of retail sales, bank deposits and real estate assessments, the indicators were projected on the basis of the growth rate from 1950 to 1960 and the assumption of a straight line growth. The straight line equation used in the computer projections was $y = a + bx$, which is illustrated in Figure 2. In the case of retail sales the base period from which the projections were made was from 1954 to 1958; for bank deposits it was 1958 to 1960; and for real estate assessments, 1956 to 1962. The base period for these indicators^{7/} differed because one of the apparent weaknesses in using secondary source data for a study of this nature is that many of the indicators selected or needed lack sufficient historical reference points to enable a sophisticated projection procedure. However, this shortcoming can be overcome by periodic updating of the information. And in the author's opinion the advantages of being able to measure benefits from governmental expenditures rapidly and economically far outweigh the minor disadvantages incurred in any lack of historical data.

^{7/} Retail sales, bank deposits and real estate assessments.



Area 1

Chesterfield County
 Hanover County
 Henrico County
 Richmond
 Dinwiddie County
 Prince George County
 Colonial Heights
 Hopewell
 Petersburg

Area 2

Smyth County
 Washington County
 Wythe County
 Bristol

Area 3

Arlington County
 Fairfax County
 Fauquier County
 Prince William County
 Alexandria
 Fairfax
 Falls Church

Area 4

Caroline County
 Spotsylvania County
 Stafford County
 Fredericksburg

Area 5

Frederick County
 Rockingham County
 Shenandoah County
 Warren County
 Harrisonburg
 Winchester

Area 6

Augusta County
 Rockbridge County
 Lexington
 Staunton

Area 7

Botetourt
 Roanoke County
 Roanoke
 Salem

Area 8

Montgomery County
 Pulaski County
 Radford

Area 9

Greensville County
 Emporia

Area 10

Nansemond County
 Chesapeake
 Norfolk
 Portsmouth
 Virginia Beach
 Suffolk

Area 11

Alleghany County
 Covington
 Clifton Forge

Area 12

Mecklenburg County

Area 13

New Kent County

Area 14

Goochland County
 Louisa County

Area 15

James City County
 York County
 Hampton
 Newport News
 Williamsburg

Figure 1. Locations of Study Areas

STRAIGHT LINE PROJECTION

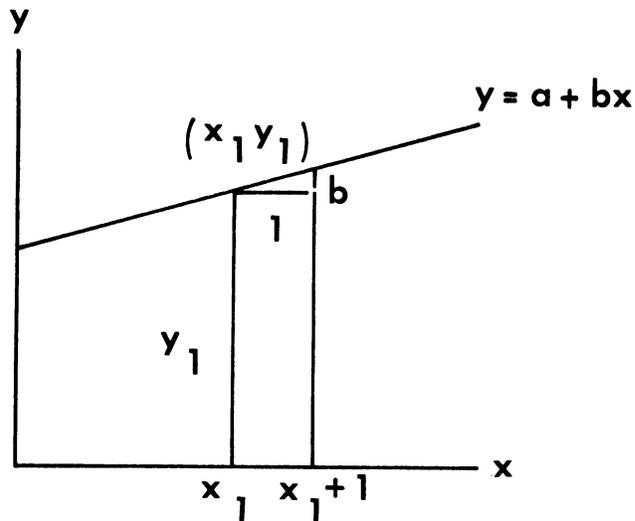


Figure 2.

An illustration of the projection procedure used is shown in Figure 3, which projects manufacturing employment for the Richmond-Petersburg area based on a straight line projection from 1950 to 1960, and gives the estimates from the Virginia Employment Commission for 1961 through 1968 that were actually plotted to analyze the net impact on the area.

One will note in Figure 3 that there is a marked increase in manufacturing employment in the Richmond-Petersburg area starting in 1963, when the author considers the interstate to have been opened.^{8/} For the purposes of this study only that portion of manufacturing employment which is above the projected line, the dotted line in Figure 3, is claimed as a benefit as a result of the highway facility.

^{8/} The author recognizes that the Interstate 95 portion known as the Richmond-Petersburg Turnpike actually opened in 1958, however, the connecting link north of I-95 was not opened until 1963; therefore for the purposes of this study 1963 is selected as the opening of this interstate facility.

MANUFACTURING EMPLOYMENT
RICHMOND PETERSBURG AREA

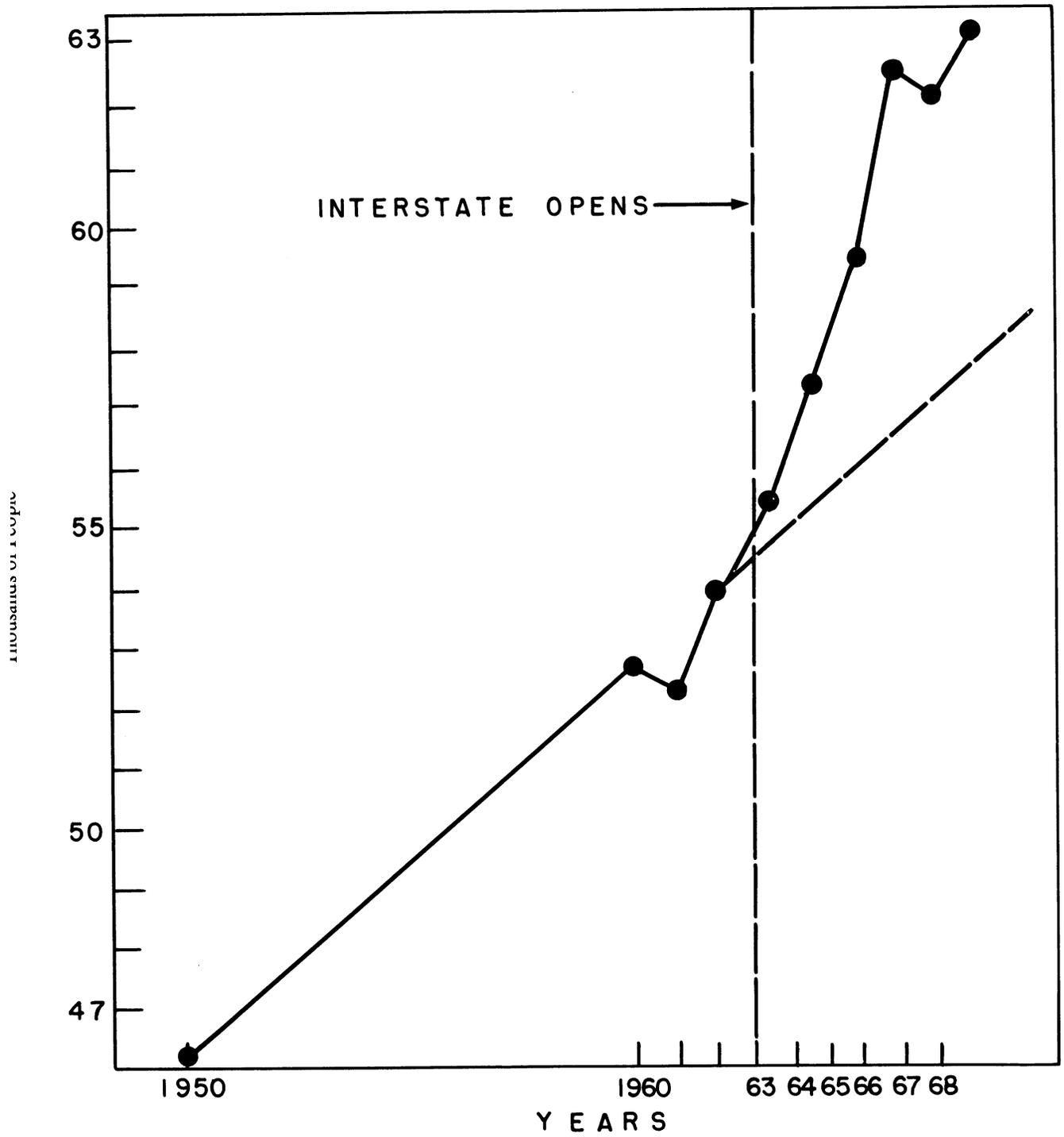


Figure 3

Source: Virginia Employment Commission Research Statistics and Information Division.

IV. SELECTION OF INDICATORS

As explained earlier this study was primarily an evaluation of income expansion generated by the interstate highway. Data on the variables chosen for analysis are readily available from reliable secondary sources, and in the researcher's opinion are important measures of changes in the economy of a community. The following indicators were selected for analysis:

- A — Personal income generated by changes in manufacturing employment.
- B — Personal income generated by changes in non-manufacturing employment.
- C — Variations in private investments.
- D — Shifts in real estate taxes.
- E — Deviations in state income tax payments due to population changes.

These indicators are discussed in the following subsections. In addition, there is a subsection summarizing the contributions.

A. Manufacturing Employment

Manufacturing employment was selected as opposed to work force or total employment because the estimates on this labor segment provided by the Virginia Employment Commission are more accurate than the figures for work force or total employment. This is true because very few manufacturing firms employ less than four people, and therefore have to file contribution reports with the local employment service.

Table 1 represents a comparison similar to the one made for each of the fifteen study areas, where a straight line projection made on the basis of the growth rate of the period 1950 to 1960 was compared to the estimates furnished by the Virginia Employment Commission.

After the change in manufacturing employment for each of the study areas was obtained the per capita personal income per year generated by new manufacturing per employee was multiplied by the change in manufacturing employment to estimate the contribution that would be attributable to the highway construction. An example of the calculations is shown in Table 2 for Study Area 1; a similar table was constructed for each of the fifteen study areas. Table 3 is a summary of this comparison for all fifteen study areas.

TABLE 1
MANUFACTURING EMPLOYMENT FOR MONTH OF MARCH
IN STUDY AREA 1

Year	Projected ^{1/} Manufacturing Employment	VEC-March Manufacturing Employment	Change
1950	46,157		
1960	52,619		
1961	53,313		
1962	54,016		
1963	54,728	55,214	486
1964	55,450	57,198	1,748
1965	56,181	59,371	3,190
1966	56,922	62,594	5,672
1967	57,673	62,091	4,418
1968	58,434	63,216	4,782

^{1/} Projected on the basis of growth of this area between 1950-1960.

TABLE 2
ESTIMATED CONTRIBUTION DUE TO CHANGE IN
MANUFACTURING EMPLOYMENT IN STUDY AREA 1

Year	Manufacturing Employment Change	Per Capita ^{1/} Personal Income	Manufacturing Contribution
1963	486	\$ 7,100	\$ 3,450,660
1964	1,748	7,100	12,410,800
1965	3,190	7,100	22,649,000
1966	5,672	7,100	40,271,200
1967	4,418	7,100	31,367,800
1968	4,782	7,100	33,952,200

^{1/} Based on a 1962 study by the Chamber of Commerce of the United States of America, What New Industrial Jobs Mean to a Community.

TABLE 3
 SUMMARY OF ESTIMATED CHANGE IN CONTRIBUTIONS FROM
 MANUFACTURING EMPLOYMENT FOR ALL AREAS, 1961-1968

Areas	1961	1962	1963	1964	1965	1966	1967	1968
1			486	1,748	3,190	5,672	4,418	4,782
2				(173)	169	665	650	1,194
3 ^{1/}		666	730	1,364	1,259	2,062	2,282	2,145
4				(202)	(193)	(49)	263	(155)
5					589	1,241	555	1,532
6 ^{2/}								
7 ^{1/}		419	244	269	1,104	1,683	1,765	2,547
8						150	1,294	3,147
9			42	116	106	551	555	660
10					968	1,458	2,645	3,369
11				348	653	1,125	1,614	1,235
12					537	489	202	194
13				6	40	87	77	52
14 ^{2/}								
15	169	3,162	1,975	801	811	(250)	708	2,003
TOTAL	169	4,247	3,477	4,277	9,233	14,884	17,028	22,705

1/ Change started 2 years before the opening of the interstate.

2/ Interstate opened in 1968.

Table 4 demonstrates the estimated increased personal income that resulted from changes in manufacturing employment caused by the development of the interstate system in all of the study areas. For the period 1961 to 1968 increases in manufacturing employment generated \$539,742,000 in additional personal income for all the study areas. However, some temporary losses did occur in some areas. This does not appear to be unusual since the economies of some communities do not adjust as rapidly as do those of some others. For example, Table 3 indicates that in the Northern Virginia area (Study Area 7) the changes started two years before the interstate opened; the data for the Bristol area (Study Area 2) indicate a temporary loss in the first year after I-81 opened.

TABLE 4

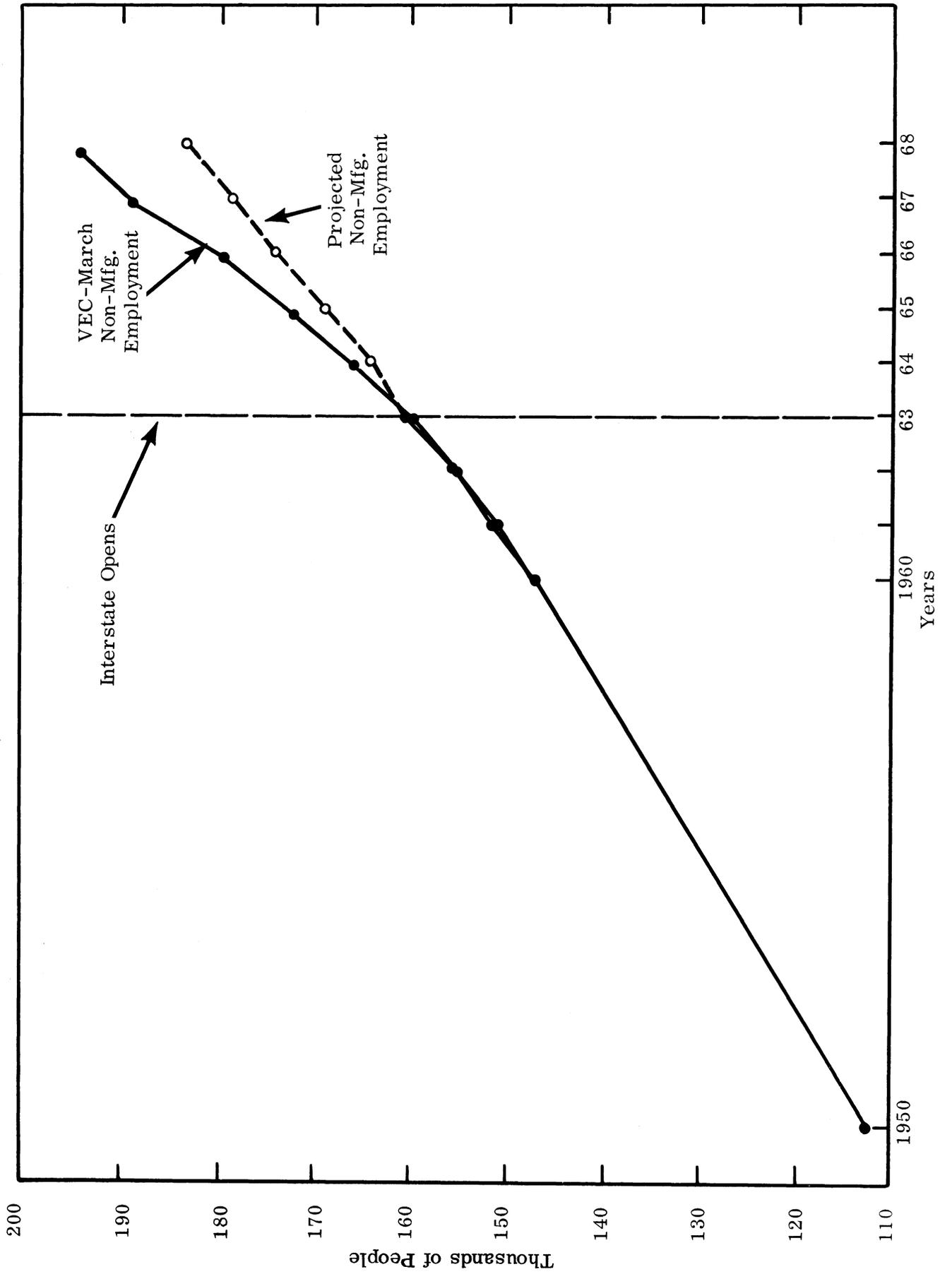
ESTIMATED INCREASE IN PERSONAL INCOME DUE TO CHANGE IN
MANUFACTURING EMPLOYMENT RESULTING FROM THE INTERSTATE SYSTEM

Year	Total Change All Study Areas	Per Capita Contribution ^{1/}	Estimated Contribution (000's)
1961	169	\$ 7,100	\$ 1,199.9
1962	4,247	7,100	30,153.7
1963	3,477	7,100	24,686.7
1964	4,277	7,100	30,366.7
1965	9,233	7,100	65,554.3
1966	14,884	7,100	105,676.4
1967	17,028	7,100	120,898.8
1968	22,705	7,100	161,205.5
TOTAL			\$ 539,742.0

^{1/} Based on a 1962 study by the Chamber of Commerce of the United States of America, What New Industrial Jobs Mean to a Community.

B. Non-Manufacturing Employment

Non-manufacturing employment was selected as a primary input since it has characteristics similar to those of manufacturing employment; that is, few approximations are used in the computation of the employment estimates in this segment, plus the fact that non-manufacturing employment expansion generally follows an increase in manufacturing positions. The estimated contributions due to changes in non-manufacturing employment for Study Area 1 are shown in Figure 4. Table 5 compares the projected Study Area 1 results with current estimates from the Virginia Employment Commission.



Source: Virginia Department of Commerce

Figure 4

TABLE 5

ESTIMATED CONTRIBUTION DUE TO CHANGES IN NON-MANUFACTURING
EMPLOYMENT IN STUDY AREA 1

Year	Projected Non-Manufacturing Employment	VEC-March Non-Manufacturing Employment	Change
1950	112,125		
1960	147,583	147,583	
1961	151,695	150,936	
1962	155,921	154,881	
1963	160,265	159,106	(1,159)
1964	164,730	165,300	570
1965	169,319	171,855	2,536
1966	174,036	179,258	5,222
1967	178,885	188,071	9,186
1968	183,869	193,578	9,709
TOTAL			28,382

Source: Virginia Employment Commission, Research Statistics Information Division.

Table 6 summarizes the changes in non-manufacturing employment within the areas having an interstate highway. The totals from this table were then used in Table 7 to compute the estimated contribution through additional personal income.

The data in both Tables 5 and 6 indicate temporary losses as the economy adjusted to the new environment. Some small businesses may not have sufficient capital to relocate immediately, and in a few instances cannot finance relocation at all.

Table 7 estimates the additional personal income that resulted from changes in non-manufacturing employment in the areas having an interstate highway. This contribution amounts to \$1,571,748,300 in additional personal income for the period 1963 to 1968. During this same period the highway contributed 69,475 more employment opportunities in the non-manufacturing sector. This contribution resulted from new facilities designed to serve both the highway user and the resident population of the area. In addition to the development adjacent to the interstate, changes occurred on the parallel routes. The economic transformation along the existing highway generally reflected a shift from firms primarily dependent on motorists to businesses oriented toward serving the community as a whole.

TABLE 6
NON-MANUFACTURING EMPLOYMENT CHANGES IN AREAS
WITH AN INTERSTATE HIGHWAY, 1963-1968

Areas	1963	1964	1965	1966	1967	1968
1	(1, 159)	570	2, 536	5, 222	9, 186	9, 709
2		1, 314	1, 555	1, 506	2, 283	2, 938
3		3, 007	11, 170	21, 052	21, 421	27, 667
4		750	982	2, 406	2, 786	1, 340
5	513	1, 407	2, 188	2, 439	2, 723	2, 518
6 ^{1/}						
7	2, 717	3, 769	5, 570	7, 120	8, 188	9, 688
8			3, 154	3, 858	4, 665	6, 401
9	(10)	(148)	(179)	(309)	5	(181)
10					1, 301	2, 022
11		137	336	465	352	570
12			784	1, 010	1, 325	1, 354
13				49	38	38
14 ^{1/}						
15	560	932	2, 427	3, 592	4, 333	5, 411
TOTAL	2, 621	11, 738	30, 523	48, 410	58, 606	69, 475

^{1/} Opened in 1968.

TABLE 7

ESTIMATED CONTRIBUTION DUE TO CHANGES IN NON-MANUFACTURING
EMPLOYMENT RESULTING FROM THE INTERSTATE SYSTEM

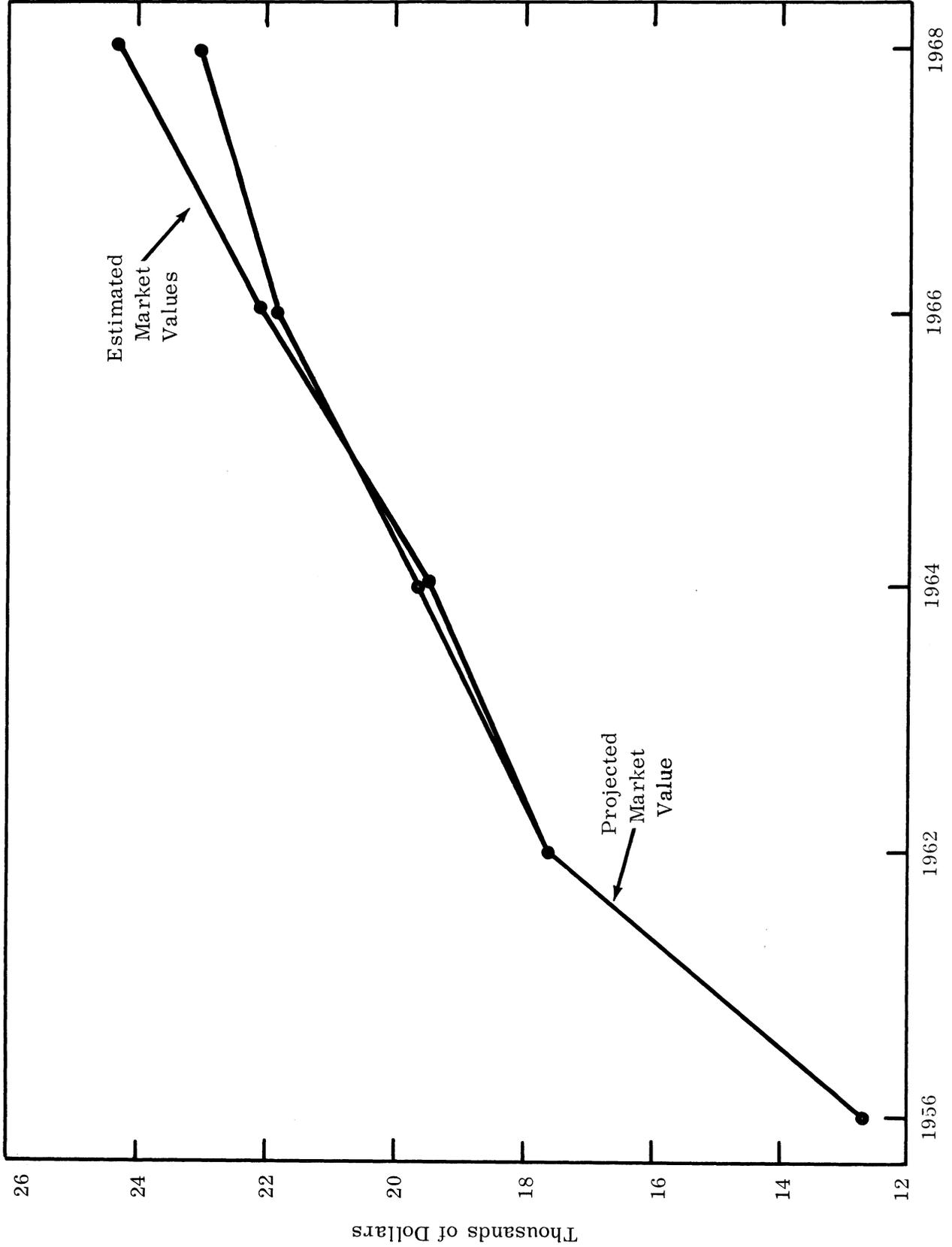
Year	Total Employment Change For All Study Areas	Per Capita Contribution	Estimated Contributi
1963	2,621	\$ 7,100	\$ 18,609.1
1964	11,738	7,100	83,339.8
1965	30,523	7,100	216,713.3
1966	48,410	7,100	343,711.0
1967	58,606	7,100	416,102.6
1968	69,475	7,100	493,272.5
TOTAL			\$ 1,571,748.3

C. Private Investments

The estimated market value of real estate was selected as an indicator of highway impact because by use of this factor one is actually able to measure more than one indicator. For example, a substantial portion of the increase in market value within the areas is created by new construction or expansion of present facilities, and would therefore reflect contributions to the building trades, furniture and office supply outlets, mortgages and bank loans, and numerous other services and supplies demanded by the expansion of both residential and commercial properties.

Figure 5 shows the estimated contributions due to changes in private investment for Study Area 1. Table 8 provides an example of the comparison made between the projected estimated market value of real estate and actual estimates developed from the Annual Report of the Department of Taxation for each of the study areas. The estimated market value is developed by inflating the assessed values shown in the Annual Report of the Virginia Department of Taxation by the assessment ratio established by the real estate appraisal section of the Department of Taxation. An assessment ratio, for those who are not familiar with these data, is actually developed by sending expert appraisers into the municipality every two years to estimate the market value of property in the county or city. The market value is then compared to the assessment made by the community. (Based on this analysis, the Real Estate and Appraisal Section of the Department of Taxation publishes biannually a list of assessment ratios for each county and city in the state. Examples of these assessment ratios are shown in Appendix C of this report.)

STUDY AREA 1, (RICHMOND-PETERSBURG AREA)



Years
Figure 5

**ESTIMATED CONTRIBUTIONS DUE TO CHANGES IN PRIVATE
INVESTMENTS IN STUDY AREA 1
(In Thousands of Dollars)**

Year	Projected Market Values	Estimated Market Values	Change
1956	\$ 12,786.500		
1962	17,654.000		
1964	19,435.700	\$ 19,623.000	
1966	22,199.400	21,840.000	\$ 358.500
1968	24,334.300	23,042.1	1,292.200
TOTAL			\$ 1,650.700

Source: Virginia Department of Taxation Annual Reports.

Therefore, having established the assessment ratio, one is able to convert the assessed values by county and city to estimated market values. An example of this conversion is shown below:

$$\frac{\text{Real Estate Assessment}}{\text{Assessment Ratio}} = \text{Estimated Market Value}$$

$$\$1,000,000 \div .40 = \$2,500,000$$

A weakness of this procedure, however, is that assessment ratios are established biannually and will not necessarily hold for any years other than the specific year for which they are developed.

Table 9 shows the estimated market value of real estate in areas with an interstate highway. This table represents a summary of the individual analyses made of the fifteen study areas, and indicates that Virginia's interstate system stimulated \$2,830,784,000 in private investments between 1964 and 1968.^{1/} Included in the increased private investment are such facilities as new industrial plants, shopping centers, apartment complexes and residential developments.

D. Real Estate Taxes

For each of the study areas real estate taxes were projected on a straight line basis based on the growth rates from 1950 to 1960 as shown in Figure 6. Projections were then compared to the actual taxes reported by the Virginia Department

^{1/} 1968 figures were not available for all areas at the time this study was conducted.

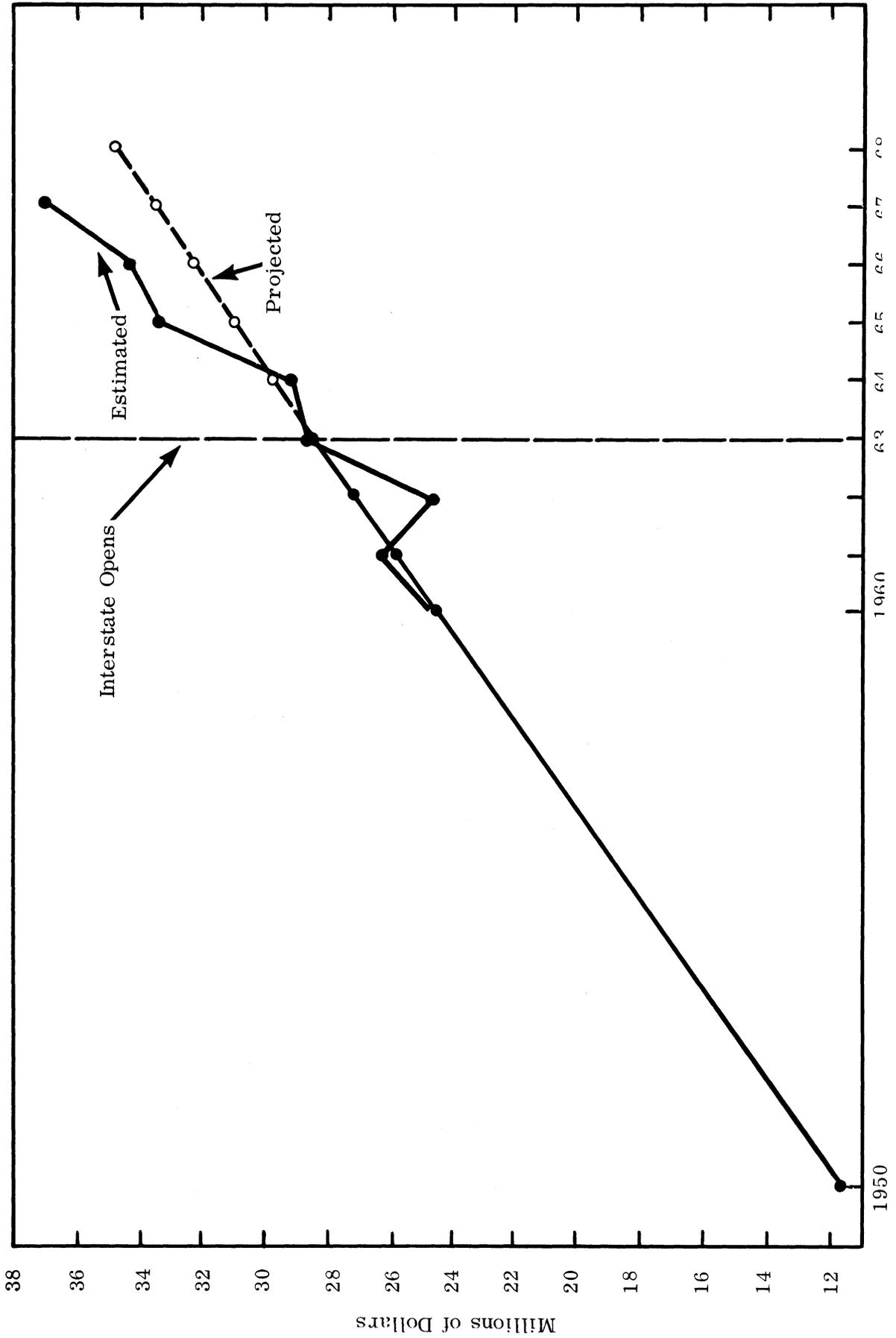
TABLE 9

ESTIMATE OF PRIVATE INVESTMENT, 1964-1967

Areas	1964	1966	1967 ^{1/}	Total
1		\$ 385,500	\$ 1,292,200	\$ 1,677,700
2	\$ 84,240.1	104,082.5	125,068.4	313,391.0
3	106,321.2	422,318.1	879,781.1	1,408,420.4
4	15,207.7	13,843.3	9,490.3	38,541.4
5	11,229.6	35,681.7	68,567.5	115,478.8
6	3,087.7	3,079.8	5,986.4	12,153.9
7	18,488.2	3,542.9	17,094.0	39,125.1
8	12,009.9	21,272.7	34,317.3	67,599.9
9	(2,683.5)	(4,153.7)	(5,584.0)	(12,421.2)
10	43,280.8	173,302.5	336,538.8	553,122.1
11	(1,464.4)	13,908.0	34,623.9	49,996.5
12	897.4	8,280.0	18,033.7	27,211.1
13	(2,005.0)	(640.3)	1,521.0	4,166.3
14	3,041.7	6,112.8	10,393.9	19,548.4
15	(187.3)	358.5	1,292.2	1,838.0
TOTAL	\$ 304,144.7	\$ 849,126.8	\$ 1,677,512.5	\$ 2,830,784.0

^{1/} 1968 figures were not available in all areas at the time this study was conducted.

CHANGES IN REAL ESTATE TAXES - STUDY AREA 1, (RICHMOND-PETERSBURG AREA)



of Taxation. An example of the comparison developed for each study area is shown in Table 10.

The results of the analysis of all fifteen study areas, shown in Table 11, indicate that Virginia's interstate system contributed toward an increase of \$183,833,300 in real estate taxes between 1961-1968.

One of the most obvious effects of the construction of a highway facility in an area is the change in population as shown in Figure 7; however, population increases not only create demands for additional services but generate additional taxes and personal income.

TABLE 10

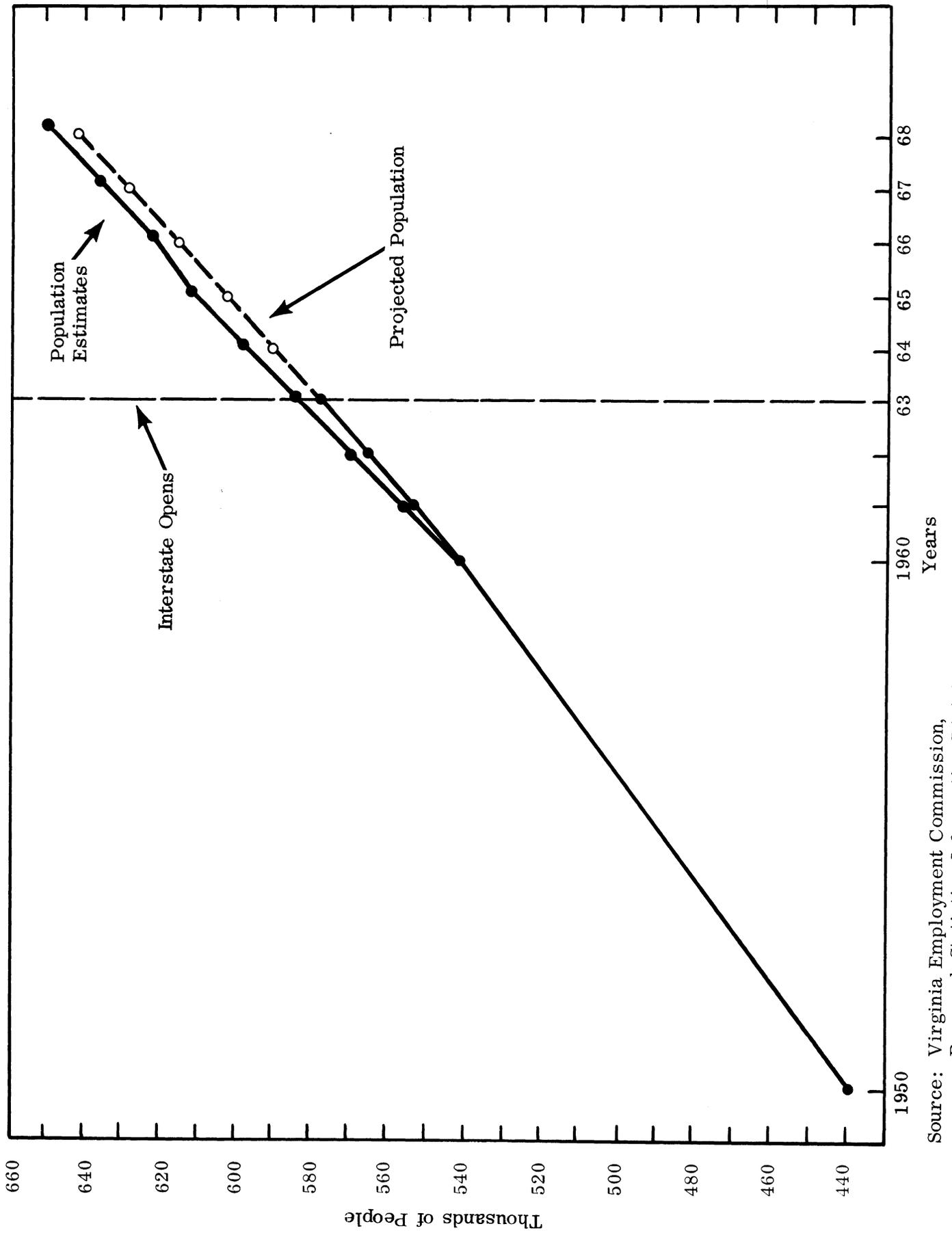
CHANGES IN REAL ESTATE TAXES IN STUDY AREA 1

Year	Projected	Estimated	Difference
1950	\$ 11,517,883	\$ 11,517,883	\$
1960	24,507,498	24,507,498	
1961	25,806,460	26,010,024	203,563
1962	27,105,421	24,512,541	(2,592,880)
1963	28,404,383	28,486,489	82,106
1964	29,703,344	31,088,383	1,385,038
1965	31,002,306	33,324,695	2,322,388
1966	32,301,267	34,440,899	2,139,631
1967	33,600,229	36,969,182	3,368,952
1968	34,899,191	N/A	N/A
TOTAL	\$ 267,342,499	\$ 250,857,594	\$ 9,501,678

TABLE 11
SUMMARY OF CHANGES IN REAL ESTATE TAXES FOR ALL AREAS, 1961-1967

Areas	1961	1962	1963	1964	1965	1966	1967	Total
1			82.1	1,385.0	2,322.4	2,139.6	3,369.0	9,298.1
2					110.3	120.1	173.1	403.5
3				12,486.6	20,489.5	27,894.4	33,003.5	98,874.0
4				344.6	645.9	783.7	891.9	2,666.1
5					397.0	504.0	602.0	1,503.0
6					361.1	470.0	506.3	1,337.4
7			960.6	1,250.5	1,094.0	1,012.7	1,261.1	5,578.9
8					242.1	271.3	568.9	1,082.3
9			54.9	55.1	55.6	69.2	71.7	306.5
10				5,064.2	5,780.3	6,247.0	7,084.5	24,176.0
11 ^{1/}			156.3	164.9	160.0	162.4	140.1	783.7
12					89.9	106.7	104.8	301.4
13							39.3	39.3
14							344.9	344.9
15	(163.0)	283.4	606.9	1,198.8	1,638.8	2,146.3	3,040.1	8,751.3
TOTAL	(163.0)	283.4	1,860.8	21,949.7	33,386.9	75,314.3	51,201.2	183,833.3

^{1/} Change in the trend started several years before opening of interstate.



Source: Virginia Employment Commission, Statistical Information Division

E. State Income Taxes

For each of the study areas, population was projected on a straight line based on the growth rates from 1950 to 1960. Projections were then compared to the latest population estimates.^{9/} An example of this comparison, which was developed for each study area, is shown in Table 12.

TABLE 12

POPULATION CHANGES IN STUDY AREA 1

Year	Projected Population	Population Estimates	Change
1950	439,903		
1960	542,729		
1961	554,251	557,537	3,286
1962	566,018	572,252	6,234
1963	578,035	587,144	9,109
1964	590,307	600,606	10,299
1965	602,839	615,069	12,230
1966	615,637	625,972	10,335
1967	628,707	639,807	11,100
1968	642,054	654,767	12,713
TOTAL			75,306

The average per capita state income tax was then developed from the Annual Reports of the Virginia Department of Taxation. The formula for estimating the average tax is shown below.

^{9/} The estimates for 1961 to 1965 were supplied by the Virginia Employment Commission Research and Statistics Division. The estimates for 1966 through 1968 were supplied by the Bureau of Population and Economic Research at the University of Virginia. The reason for using the two different sources for population estimates is that in 1965 the Census Bureau designated the Bureau of Population and Economic Research as the official agency for making estimates for each county and each city within the state between the years when the regular census is conducted.

Example: (For the taxable year 1966)

$$\frac{\text{Net Taxes Paid}}{\text{Number of Returns}} = \text{Average Per Capita State Income Tax Paid}$$

$$\frac{\$ 165,769,701}{1,485,876} = \$ 111.56$$

The average per capita state income tax was developed for each of the years 1961 through 1968. The table showing the source data and the per capita income tax is given in Appendix B of this report.

In order not to overstate the population change that might be attributable to the construction of the interstate system, the researcher compared the total population change claimed in the study areas with the net in migration figure for the state as a whole. The purpose of this comparison was to confirm that the population growth claimed was not just a population redistribution. The population growth claimed as a result of the construction of the interstate is slightly less than half of the net migration into Virginia for the period April 1, 1960 to July 1, 1968; therefore it was assumed that all of the growth for the study areas reflected in migration to the area and represented new contributors to Virginia's economy.

One of the contributions to the economy of the Commonwealth of course would be state income tax payments. Based on the above assumption an estimate of the state income tax payments was developed for each of the fifteen study areas in a manner similar to that illustrated in Table 13.

TABLE 13

ESTIMATE OF STATE INCOME TAX PAYMENTS FOR STUDY AREA 1

Year	Population Change	Per Capita Tax	Net State Income Tax Paid
1963	9,109	\$ 88.61	\$ 807,148
1964	10,299	96.66	995,501
1965	12,230	105.88	1,294,912
1966	10,335	111.56	1,152,973
1967	11,100	117.47	1,303,917
1968	12,713	\$ 123.70	\$ 1,572,598

Table 14 shows the results of a comparison of population estimates and projections for each of the fifteen study areas. The change in each of the areas was then used in a manner somewhat like that shown in Table 13 to arrive at an estimate of the increase in state income tax payments as a result of the interstate system. This calculation estimated that Virginia received an additional \$52,167,200 in state income tax payments. The summary of all areas is shown in Table 15.

F. Summary of Contributions

Each of the indicators examined in this report show substantial benefits resulting from the construction of Virginia's portion of the interstate system. However, if all of these variables were used in the return on investment model the rate of return would be overstated due to double counting.

After considerable analysis, only the manufacturing and non-manufacturing employment contributions were selected to compute the rate of return. The other variables were examined in depth, but it was the researcher's judgement that to include them would be to overstate the rate of return. The rationale for the omission of specific factors from the return on investment model are discussed succinctly below:

Private Investment — The amount of private investments stimulated in a community is a vital factor since it measures several other indicators such as contributions to the building trades, furniture and office supply outlets, mortgages, bank loans and numerous other services; however, it was impossible to isolate the amount of residential expansion^{10/} accurately within the time constraints of this study. Therefore, rather than overstate the rate of return, it was not used in the return on investment model.

Real Estate Taxes — Generally taxes are required revenue of communities; they vary according to the services demanded by the community as a whole; and therefore, they may not be truly indicative of the highway impact.

State Income Tax Payments — Use of this factor would be a double counting since it would be reflected in personal income.

^{10/} Inclusion of the expenditures for residential expansion would constitute double counting since personal income was used as a factor.

TABLE 14
POPULATION CHANGE IN AREAS WITH AN INTERSTATE HIGHWAY, 1961-1968

Areas	1961	1962	1963	1964	1965	1966	1967	1968
1			9,109	10,299	12,230	10,335	11,100	12,713
2				1,043	1,413	3,539	2,916	2,993
3			13,389	10,625	(3,114)	12,462	3,838	6,514
4				2,368	2,887	2,782	3,249	3,313
5						9,918	6,197	5,815
6							4,603	4,152
7				5,885	9,184	4,098	(1,099)	691
8					5,069	5,110	6,369	10,698
9			212	330	722	918	1,169	1,175
10	7,897	14,883	21,596	27,952	29,602	25,943	18,983	18,229
11						4,327	4,609	5,438
12					2,439	4,316	4,482	4,536
13			360	381	372	263	236	108
14 ^{1/}								
15	3,165	5,535	8,815	10,096	12,301	7,156	4,987	3,967
TOTAL	11,062	33,807	57,294	68,979	73,105	91,167	71,639	80,342

^{1/} Interstate opened in 1968.

TABLE 15

ESTIMATE OF INCREASES IN STATE INCOME TAX PAYMENTS
 RESULTING FROM THE INTERSTATE SYSTEM, 1961-1968
 (In Thousands of Dollars)

23
 33
 08

Areas	1961	1962	1963	1964	1965	1966	1967	1968
1			807.1	995.5	1,294.9	1,153.0	1,303.9	1,572.6
2				100.8	149.6	394.8	342.5	370.2
3	483.1	1,108.7	1,524.3	1,027.0	(329.7)	1,390.3	450.9	805.8
4				228.9	305.7	310.4		409.8
5						1,106.5		719.3
6							540.7	513.6
7				568.8	972.4	457.2	(129.1)	85.5
8					536.7	570.1		1,323.3
9			18.8	31.9	76.4	102.4	137.3	145.3
10	625.1	1,232.5	1,913.6	2,701.8	3,134.3	2,894.2	2,229.9	2,254.9
11						482.7	541.4	672.7
12					258.2	481.5	526.5	561.1
13			31.9	36.8	39.4	29.3	27.7	13.4
14 ^{1/}								
15	250.6	458.4	781.1	975.9	1,302.4	798.3	585.8	490.7
TOTAL	1,358.8	2,799.6	5,076.8	6,667.4	7,740.3	10,170.7	8,415.4	9,938.2

52,167.2

^{1/} Opened in 1968.

A summary of the benefits accruing to all of the study areas is shown in Table 16.

TABLE 16

SUMMARY OF NET CONTRIBUTIONS TO THE ECONOMY
OF VIRGINIA FROM ALL STUDY AREAS
(In Thousands of Dollars)

Year	Manufacturing Employment	Non-Manufacturing Employment	Total
1961	1,199.9		1,199.9
1962	30,153.7		30,153.7
1963	24,686.7	18,609.1	43,295.8
1964	30,366.7	83,339.8	113,706.5
1965	65,554.3	216,713.3	282,267.6
1966	105,676.4	343,711.0	449,387.4
1967	120,898.8	416,102.6	537,001.4
1968	161,205.5	493,272.5	654,478.0
TOTAL			2,111,490.3

V. COST OF THE INTERSTATE

A. Construction and Maintenance Costs

In establishing the construction and maintenance costs for the interstate system in Virginia it was necessary to use two different sources, one the Annual Reports of the Virginia Department of Highways and the other the Annual Reports of the Richmond-Petersburg Turnpike Authority. Table 17 reflects the construction, maintenance and maintenance replacement expenditures by the Virginia Department of Highways for the period 1957 to 1968. Table 18 reflects the construction costs and maintenance and operation costs for the Richmond-Petersburg Turnpike Authority for the period 1958 to 1968.

TABLE 17

INTERSTATE INVESTMENTS
(By the Department of Highways)

Fiscal Year	Construction	Maintenance	Maintenance Replacement
1957	\$ 1,556,062		
1958	16,544,061		
1959	32,602,017		
1960	36,490,302	\$ 7,567	
1961	49,022,070	51,942	
1962	68,596,481	140,923	
1963	92,641,310	455,743	\$ 24,845
1964	124,580,032	882,113	35,223
1965	140,129,185	1,283,829	134,468
1966	122,448,000	2,104,000	74,000
1967	107,010,000	3,009,000	156,000
1968	94,814,000	3,347,000	121,000
TOTAL	\$ 886,433,520	\$ 11,282,117	\$ 545,536

Source: Annual Reports of Virginia Department of Highways (1957-1968)

TABLE 18

RICHMOND-PETERSBURG TURNPIKE CONSTRUCTION
AND MAINTENANCE AND OPERATION COSTS

Year	Construction	Maintenance and Operation
1958	\$ 74,299,774	\$ 478,521
1959	N/A (Included in 1960 figure)	777,486 ^{2/}
1960	1,970,013	1,076,450
1961	170,391	1,102,026
1962	131,612	1,144,690
1963	(3,718)	1,200,808
1964	353	1,225,451
1965	707	1,287,532
1966	576	1,350,218
1967	-0-	1,538,139
1968	1,001,107 ^{1/}	1,703,926
TOTAL	\$ 77,570,815	\$ 12,107,761

^{1/} Cost of constructing interchange of I-64 with I-95

^{2/} The maintenance and operation figure was estimated for 1959 by interpolation between 1958 and 1960.

In establishing the investments in the interstate system, the Hampton Roads Bridge Tunnel System was not included since the bonds for this facility were issued in 1954, which was prior to the time the interstate system came into being. When the interstate system was started, it of course was connected to the Hampton Roads Bridge Tunnel system. The Bridge Tunnel system is actually operated and maintained from toll revenues and is not considered a part of the interstate system. However, there is a small connection between routes U. S. 250 and U. S. 17 which is designated as part of the interstate system and is reflected in the Department's construction figures for the entire system. In addition to the Hampton Roads facility the Virginia Beach toll road authority is omitted, since it is not designated as a portion of the interstate system and is financed with toll revenues that are used to pay maintenance cost and retire the original bond issue.

The researcher attempted to develop construction and maintenance costs for each study area so as to be consistent with the development of benefits. However, neither the Fiscal or the Construction Divisions of the Highway Department

was able to supply this information easily. It could have been developed only by auditing individual construction project reports, which was impossible within the time constraints.

It would have been possible to establish an average annual cost per mile and then distribute the cost to the individual study area according to the miles opened in a given year. This would have been a substantial approximation and would not have necessarily reflected the true costs in each area, since some costs differ from area to area, for example, the costs for labor, grading, right-of-way, and materials. Therefore, it was impossible to compute the rate of return for each study area.

VI. RETURN ON INVESTMENT ANALYSIS

A. Methods Available for Calculation of Return on Investment

There are numerous methods of computing rates of return on investment. Taylor gives six different formulas which might be used for different situations. To assist the reader in understanding the formulas the following symbols are used in Mr. Taylor's rate of return formulas:

- "P designates a present sum of money. On the time scale it occurs at point zero or at another point from which we choose to measure time. P, as noted, is at the beginning of the initial period.
- S designates a sum of money at a specified future date. On the time scale it occurs at point n or some future point to which we choose to go in time. S is at the end of the last period.
- R designates a uniform series of end-of-payments. To satisfy this definition they must be equal payments and they must occur at the end of every period. [The formulas are derived only for P, S, and R defined and located strictly as stated ahead.]
- i designates the interest rate earned at the end of each period. Interest is used in its broadest sense and may mean rate of return, yield, rate of profit, and so on.
- n designates the number of interest periods."^{11/}

FORMULAS SUMMARIZED^{12/}

- (1) Single-payment compound-amount factor: $S = P(1 + i)^n = P \cdot i_{-n} \text{ spcaf}$
- (2) Single-payment present-worth factor: $P = S \frac{1}{(1 + i)^n} = S \cdot i_{-n} \text{ sppwf}$

^{11/} Op. Cit., p. 23.

^{12/} Ibid., p. 27.

(3) Uniform-series compound-amount factor: $S = R \frac{(1+i)^n - 1}{i} = R \cdot i^{-n} \text{ us}$

(4) Sinking-fund deposit factor: $R = S \frac{i}{(1+i)^n - 1} = S \cdot i^{-n} \text{ sdf}$

(5) Capital-recovery factor: $R = P \frac{i(1+i)^n}{(1+i) - 1} = P \cdot i^{-n} \text{ crf}$

(6) Uniform-series present-worth factor: $P = R \frac{(1+i)^n - 1}{i(1+i)^n} = R \cdot i^{-n} \text{ uspw}$

Formulas 1 and 2 were selected for use in this study. The rationales for rejecting methods 3, 4, 5 and 6 are listed below:

- The uniform - series compound-amount factor (3) was rejected because neither the construction or maintenance costs were in uniform payments. This formula is predicated on the use of uniform payments and would have required substantial mathematical calculations to convert to uniform payments.
- The sinking - fund deposit factor (4) was not applicable because it was not the purpose of this study to measure returns to the trust fund, but rather to estimate contributions to the economy of the individual community.
- The capital-recovery factor (5) was not suitable for the reason cited for the sinking-fund deposit factor.
- The uniform series present-worth factor (6) was rejected since payments were not uniform and conversion was too time consuming.

B. Return on Investment Computed by Individual Indicators

Before the rate of return could be calculated it was necessary to adjust the contributions in two ways, which are explained below:

- 1 — The elimination of the capital investment factor^{12/} must be compensated for since the net benefits at present reflect only personal income resulting from changes in manufacturing and non-manufacturing employment. The formula for Gross National Product (GNP) does reflect capital investments and, therefore, provides a vehicle to convert personal income to the equivalent of Virginia's portion (VNP) of the National Product. The VNP factor was developed as follows:

$$\frac{\text{Personal Income of GNP}}{\text{Total GNP}} = \text{GNP Factor}$$

The above calculation determined what percent the personal income of the nation was of total GNP, which provides an inflation factor that was applied to the personal income generated by the interstate system. This adjustment, in the opinion of the researcher, partially compensates for private investment.^{13/} This relationship was developed for 1965-1968 to develop an average factor. The average GNP factor was then divided into the personal income benefits to obtain VNP as follows:

$$\frac{\text{P. I. Benefits}}{\text{GNP Factor}} = \text{VNP}$$

Table 19 shows the results of this calculation.

- 2 — The second adjustment that was made before calculating the rate of return was to adjust both the benefits^{14/} (VNP) and total construction and maintenance costs, assuming that these funds had been invested at six percent interest.

^{12/} The reader will recall that capital investments were rejected since it was impossible to isolate the double counting that might be in these data as collected within the time available for this study.

^{13/} A possible weakness of this approach is that it assumes that Virginia's personal income relationship to VNP is the same as the nation's personal income is to GNP.

^{14/} Benefits were adjusted to allow for time value.

TABLE 19

CONVERSION OF PERSONAL INCOME TO VNP
(In thousands of dollars)

Year	Change in Manufacturing	Change in Non-Manufacturing	Factor ^{1/}	VNP
1961	\$ 1,199.9		.786	\$ 1,526.6
1962	30,153.7		.786	38,363.5
1963	24,686.7	\$ 18,609.1	.786	55,083.7
1964	30,366.7	83,339.8	.786	144,664.8
1965	65,554.3	216,713.3	.786	359,119.1
1966	105,676.4	343,711.0	.786	571,739.7
1967	120,898.8	416,102.6	.786	683,207.9
1968	161,205.5	493,272.5	.786	832,669.2
TOTAL	539,742.0	1,571,748.3		\$ 2,686,374.5

^{1/} See page 39 for the development of this factor.

The author recognizes that to assume the trust funds ^{15/} could be invested in anything other than their designated purpose is purely academic. However, in order to make the return on investment analysis comparable with that of industry one must assume that management had the option of making alternative investments. For the purposes of this analysis the net benefits shown in Table 16 were adjusted for present value assuming a six percent simple interest return, and the construction and maintenance costs assuming six percent compound interest. The impact of this adjustment on the benefits is shown in Table 20, and that on the construction and maintenance costs in Tables 21 and 22. The total for the eight year period 1961-1968 shown in Table 20 in the column adjusted net contributions was used as a dividend in the first calculation. The present value factor used in Table 20 and shown as sppwf is actually the second formula, which is referred to as the single-payment present-worth factor.

^{15/} The construction and maintenance costs could have been invested in something other than highways.

TABLE 20
ADJUSTMENT OF VNP FOR PRESENT VALUE

Year	VNP	Present Value Factor (sppwf) ^{1/}	Adjusted Net Contributions
1961	\$ 1,526.6	1.504	\$ 2,296.0
1962	38,363.5	1.419	54,437.8
1963	55,083.7	1.338	73,702.0
1964	144,664.8	1.263	182,711.6
1965	359,119.1	1.191	427,710.8
1966	571,739.7	1.124	642,635.4
1967	683,207.9	1.060	724,200.4
1968	832,669.2	-0-	832,669.2
TOTAL			\$ 2,940,363.2

^{1/} Taylor, Op. Cit., p. 447

TABLE 21
ADJUSTMENT OF CONSTRUCTION COST OF THE INTERSTATE SYSTEM

Year	Construction Cost	Single-Payment Compound-Factor	Adjusted Construction Cost
1957	\$ 1,556,062	1.898	\$ 2,953.4
1958	90,843,835	1.791	162,701.3
1959	32,602,017	1.690	55,097.4
1960	38,460,315	1.594	61,305.7
1961	49,192,461	1.504	73,985.5
1962	68,728,093	1.419	97,525.2
1963	92,637,592	1.338	123,949.1
1964	124,580,385	1.263	157,345.0
1965	140,129,892	1.191	166,894.7
1966	122,448,576	1.124	137,632.2
1967	107,010,000	1.060	113,430.6
1968	95,815,107	-0-	95,815.1
TOTAL			\$ 1,248,635.2

TABLE 22

ADJUSTMENT OF MAINTENANCE COST OF THE INTERSTATE SYSTEM

Year	Maintenance Cost	Single-Payment Compound Factor	Adjusted Maintenance Cost
1958	\$ 478,521	1.791	\$ 857.0
1959	777,486	1.690	1,314.0
1960	1,084,017	1.594	1,727.9
1961	1,153,968	1.504	1,735.6
1962	1,285,613	1.419	1,824.3
1963	1,681,396	1.338	2,249.7
1964	2,142,787	1.263	2,706.3
1965	2,705,829	1.191	3,222.6
1966	3,528,218	1.124	3,965.7
1967	4,703,139	1.060	4,985.3
1968	5,171,926	-0-	5,171.9
TOTAL			\$ 29,760.3

Therefore, the adjusted calculation on rate of return would be computed as follows:

$$\frac{\text{Adjusted Net Benefits}}{\text{Adjusted Construction Cost} + \text{Adjusted Maintenance Cost}} - 100 = \text{Rate of Return}$$

$$\frac{\$2,940,363.2}{\$1,248,635.2 + \$29,760.3} - 100 = 130\%$$

Based on the above calculations there was a 130% rate of return for the eight year period 1961 to 1968, or 16.25% annually.

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APPENDIX A

DETAILED LISTING OF STUDY AREAS

AREA 1

	City or County	From	To	Length	Date Opened to Traffic
64	City of Richmond & Henrico County	Int. Rt. 95	Short Pump (Int. of 250 & Broad Street)	8.95	7-19-67
64	City of Richmond	Int. Rt. 360	Int. Rt. 95	1.90	6-13-68
64	Henrico County & City of Richmond	Int. Laburnum Ave. Extension	Int. Rt. 360	3.46	7-7-67
85	City of Petersburg & Dinwiddie County	Int. 95 in Petersburg (Exit 2)	S. End of Richmond-Petersburg Turnpike	4.68	8-4-58
95	Hanover & Henrico Cos.	Int. Rt. 54	N. End of Richmond-Petersburg Turnpike	10.96	2-9-63
95	Henrico & Chesterfield Counties & Cities of Richmond, Colonial Heights & Petersburg	N. End of Richmond-Petersburg Turnpike	S. End of Richmond-Petersburg Turnpike	29.66	7-1-58
95	City of Petersburg & Prince George County	S. End of Richmond-Petersburg Turnpike	Int. Rt. 301	6.15	10-23-62
95	Prince George County	Int. Rt. 301	0.41 Mi. S. Rt. 35	4.62	10-5-61

AREA 2

City or County	From	To	Length	Date Opened to Traffic
81 Pulaski & Wythe Counties	Rts. 100 & 101	Int. Rt. 619	5.95	8-14-62
81 Wythe County	Int. Rt. 619	Temporary Conn. at Route 11	2.63	10-25-61
81 Wythe County	1.1 Mi. W. Rt. 52	1.23 Mi. E. Rt. 52	2.31	12-4-68
81 Wythe County	Temporary Conn. at Route 11	Int. Rt. 11	6.68	9-30-65
81 Wythe & Smyth Counties	Int. Rt. 11	4.70 Mi. S. of Wythe Co. Line Smyth Co.	14.96	11-1-64
81 Smyth County	4.70 Mi. S. of Wythe Co. Line	1.03 Mi. S. of Rt. 689	4.96	10-18-63
81 Smyth County	1.03 Mi. S. of Rt. 689	Int. Rts. 11 & 645	8.64	6-28-63
81 Smyth & Washington Counties	Int. Rts. 11 & 645	Int. Rt. 91	9.90	10-19-63
81 Washington County	Int. Rt. 91	Int. Rts. 11 & 58 (N. of Abingdon)	9.73	9-20-63
81 Washington County	Int. Rt. 58 (No. of Abingdon)	Int. Rt. 611	6.57	6-28-62
81 Washington County	Int. Rt. 611	Int. Rts. 11, 19, & 58 (No. of Bristol)	7.63	9-20-63
81 Washington County	Int. Rts. 11, 19, & 58 (No. of Bristol)	Tennessee State Line	5.57	11-20-61
381 Washington County & City of Bristol	Int. Rt. 81	0.12 Mi. S. of NCL Bristol	1.45	11-20-61

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AREA 3

	City or County	From	To	Length	Date Opened to Traffic
495	City of Alexandria & Fairfax County	Int. Rt. 1	Int. Rt. 95	6.69	4-2-64
495	Fairfax County	Int. Rt. 95	Int. Rt. 50	6.73	12-16-61
495	Fairfax County	Int. Rt. 50	Int. Rt. 7	3.29	10-2-63
495	Fairfax County	Int. Rt. 7	Cabin John Bridge	4.66	12-31-62
495	City of Alexandria	ECL Alexandria	Int. Rt. 1	.82	12-28-61
95	City of Alexandria, Arlington & Fairfax Counties	Wash. D. C. (S. End of 14th St. Bridge)	1.45 Mi. N. of Fairfax & Prince William Co. Line	17.54	5-24-52
95	Fairfax & Prince William Counties	1.45 Mi. N. of Fairfax & Prince William Co. Line	Int. Rt. 619	12.07	10-31-64
66	Fauquier Co.	Temporary Conn. at Rts. 17 & 55	Temporary Conn. at Rt. 55	3.36	5-18-62
66	Arlington County	D. C.-Va. Line	0.298 Mi. E. of N. Lynn Street	.31	6-23-64
66	Arlington County	0.298 Mi. E. N. Lynn St.	0.109 Mi. E. of N. Lynn St.	.19	10-27-66
66	Fairfax County	Int. Rt. 495	Int. Rt. 29-211 at Centreville	12.82	11-18-64
66	Fairfax & Prince William Counties	Int. Rt. 29-211 at Centreville	Int. Rt. 29-211 at Gainesville	9.05	12-12-61

AREA 4

City or County	From	To	Length	Date Opened to Traffic
95 Prince William, Stafford and Spotsylvania Cos.	Int. Rt. 619	Int. Rt. 1	24.63	12-18-64
95 Spotsylvania, Caroline and Hanover Cos.	Int. Rt. 1	Int. Rt. 54	34.20	7-16-64

AREA 5

81 Frederick	W. Va. State Line	Int. Rt. 669	.36	10-19-66
81 Frederick, Warren & Shenandoah Cos.	Int. Rt. 669	Int. to Rt. 11 at Strasburg	25.97	11-4-65
81 Shenandoah County	Int. to Rt. 11 at Strasburg	Int. Rts. 211 & 260 at New Market	33.39	12-18-66
81 Shenandoah & Rockingham Counties	Int. Rts. 211 & 260	Int. Rt. 11 N. of Harrisonburg	13.80	6-6-66
81 Rockingham County	Int. Rt. 11 S. of Harrisonburg	Int. Rt. 11 N. of Harrisonburg	7.90	7-1-60

AREA 6

81 Rockingham & Augusta Cos.	Int. Rt. 11 S. of Harrisonburg	Int. Rt. 256	8.11	11-15-66
81 Augusta County	Int. Rt. 256	Int. Rt. 612	7.66	8-28-67
81 Augusta County	Int. Rt. 612	Int. Rt. 275	1.98	6-10-68
81 Augusta County	Int. Rt. 275	Int. Rt. 340	12.48	8-24-68

Area 6 (cont.)

	City or County	From	To	Length	Date Opened to Traffic
81	Augusta & Rockbridge Cos.	Int. Rt. 340	Int. Rt. 11 N. of Lexington	18.16	2-1-67
81	Rockbridge County	Int. Rt. 11 N. of Lexington	Int. Rt. 684	14.61	9-18-67
81	Rockbridge County	Int. Rt. 684	1.42 Mi. W. of Rt. 690	6.15	5-4-65
81	Rockbridge & Botetourt Counties	1.42 Mi. N. of Rt. 690	0.46 Mi. S. of Rt. 610	1.51	12-10-64

AREA 7

81	Botetourt County	0.46 Mi. S. of Rt. 610	0.87 Mi. S. of Rt. 614	5.18	11-1-60
81	Botetourt County	0.87 Mi. S. of Rt. 614	0.02 Mi. N. of Rt. 633 Underpass	6.10	8-1-63
81	Botetourt & Roanoke Cos.	0.02 Mi. N. of Rt. 633 Underpass	0.62 Mi. S. of Rt. 927 at Dixie Caverns	28.91	12-21-64
581	Roanoke County	Rt. 81	Rt. 117	1.25	12-21-64
581	City of Roanoke	Rt. 117	Rt. 625	1.54	5-28-65
581	City of Roanoke	Int. Rt. 625	Int. Rt. 460	2.84	9-14-65
581	City of Roanoke	Williamson Road	Williamson Road	.45	8-23-66

AREA 8

	City or County	From	To	Length	Date Opened to Traffic
81	Montgomery & Pulaski Cos.	Int. Rts. 11 & 460	Int. Rt. 100	19.89	11-16-65
81	Pulaski County	Int. Rt. 100	.6 Mi. S. of Rt. 100	.60	6-9-65
81	Pulaski County	.6 Mi. S. of Rt. 100	1.1 Mi. N. of Rt. 99	2.65	6-1-61
81	Pulaski County	1.1 Mi. N. of Rt. 99	Rts. 100 & 101	5.44	11-1-59

AREA 9

95	Greensville County	0.65 Mi. N. of Rt. 610	So. of Emporia	5.05	9-9-59
95	Greensville County	S. of Emporia	N. C. State Line	8.37	6-26-63

AREA 10

264	Cities of Chesapeake & Portsmouth	Rt. 13	Des Moines Ave.	5.94	12-29-64
64	City of Norfolk	Northampton Blvd.	Tidewater Drive	4.41	5-19-67
64	City of Chesapeake	Int. Rt. 264	Int. Rt. 464	8.70	1-29-69
64	Cities of Chesapeake, Virginia Beach and Norfolk	Int. Rt. 464	Northampton Blvd.	9.86	12-1-67
464	City of Chesapeake	Int. Rt. 13 (Military Highway)	0.84 Mi. N. of Rt. 64	1.54	5-31-67
264	City of Norfolk	0.16 Mi. W. of Brambleton Ave.	Virginia Beach Toll Road	4.52	12-1-67
264	City of Portsmouth	Des Moines Ave.	Washington St.	.89	12-1-66

AREA 11

	City or County	From	To	Length	Date Opened to Traffic
64	Alleghany County	0.56 Mi. W. of WCL Clifton Forge	3.98 Mi. W. of Clifton Forge	3.41	7-18-64
64	Alleghany County	3.98 Mi. W. WCL Clifton Forge	7.30 Mi. W. of Clifton Forge	3.34	12-18-64
64	Alleghany County	7.30 Mi. W. of Clifton Forge	W. Va. State Line	17.02	12-6-66

AREA 12

85	Mecklenburg County	N. C. State Line	Int. Rt. 1	15.34	11-24-65
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AREA 13

64	New Kent & Henrico Cos.	Int. Rt. 33	Int. Laburnum Ave.	9.68	1-14-66
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AREA 14

64	Henrico, Goochland & Louisa Cos.	Int. 250 at Short Pump	Int. Rt. 522	18.70	12-19-68
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AREA 15

64	City of Hampton	NCL of Norfolk (S. End of Tunnel Bridge)	Int. Rt. 258	8.56	11-1-57
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Area 15 (cont.)

	City or County	From	To	Length	Date Opened to Traffic
64	Cities of Hampton & Newport News	Int. Rt. 258 in Hampton	Int. Rt. 17 in Newport News	4.95	11-6-59
64	City of Newport News	Int. Rt. 17	Int. Rt. 143	3.21	6-21-60
64	Newport News, James City and York Cos.	Int. Rt. 143	Camp Perry	18.11	10-15-65

APPENDIX B

DEVELOPMENT OF AVERAGE PER CAPITA STATE INCOME TAX

Income Year	Taxes	No. of Returns	Per Capita Income Tax
1960	\$ 80,405,348	1,114,995	\$ 72.11
1961	90,753,483	1,146,285	79.17
1962	99,769,566	1,204,825	82.81
1963	113,317,720	1,278,868	88.61
1964	129,277,599	1,337,499	96.66
1965	148,688,087	1,404,272	105.88
1966	165,769,701	1,485,876	111.56
1967 ^{1/}			117.47
1968 ^{1/}			123.70

^{1/} Estimated by using the percentage increase between taxable years 1965 and 1966.

Source: Annual Reports of Department of Taxation (1961-1967).

APPENDIX C

REAL ESTATE ASSESSMENT RATIOS AND AVERAGE EFFECTIVE TRUE TAX RATES
IN VIRGINIA COUNTIES AND CITIES — 1964 and 1966

(Exclusive of Town Taxes Imposed by Incorporated Towns for Town Purposes)

COUNTY	Assessment Ratio		Average Nominal Tax Rate		Average Effective True Tax Rate	
	(1964)	(1966)	(1964)	(1966)	(1964)	(1966)
Accomack.....	16.8%	13.2%	\$ 5.15	\$ 5.10	\$ 0.87	\$ 0.67
Albemarle.....	13.4	12.8	4.25	4.80	.57	.61
Alleghany.....	21.1	17.4	4.30	4.30	.91	.75
Amelia.....	24.2	21.4	3.00	3.00	.73	.64
Amherst.....	11.4	18.2	3.72	3.12	.42	.57
Appomattox.....	20.7	20.3	2.75	2.75	.57	.56
Arlington.....	33.8	33.8	3.87	3.87	1.31	1.31
Augusta.....	24.1	25.6	2.90	3.10	.70	.79
Bath.....	28.3	23.5	2.64	2.57	.75	.60
Bedford.....	15.5	16.6	3.65	3.45	.57	.57
Bland.....	12.3	12.4	5.14	5.14	.63	.64
Botetourt.....	16.7	16.7	4.90	4.00	.82	.67
Brunswick.....	22.0	18.6	3.00	3.00	.66	.56
Buchanan.....	11.1	12.0	5.90	5.90	.65	.71
Buckingham.....	24.1	22.2	2.10	2.10	.51	.47
Campbell.....	21.1	20.8	3.40	3.00	.72	.62
Caroline.....	16.8	17.6	3.00	3.00	.50	.53
Carroll.....	9.7	9.8	5.20	5.20	.50	.51
Charles City.....	19.2	18.0	4.25	4.25	.82	.77
Charlotte.....	13.5	12.0	3.60	3.50	.49	.42
Chesterfield.....	32.2	32.2	2.80	2.80	.90	.90
Clarke.....	13.0	20.0	3.10	2.30	.40	.46
Craig.....	18.1	17.7	3.30	3.30	.60	.58
Culpeper.....	20.0	18.3	2.40	2.80	.48	.51
Cumberland.....	18.0	16.2	3.60	3.60	.65	.58
Dickenson.....	10.5	9.2	7.00	7.00	.74	.64
Dinwiddie.....	19.1	18.9	3.00	3.00	.57	.57
Essex.....	32.3	29.3	1.85	1.85	.60	.54
Fairfax.....	34.9	35.6	3.77	4.07	1.32	1.45
Fauquier.....	14.0	12.3	3.20	3.75	.45	.46
Floyd.....	22.5	20.1	4.00	4.00	.90	.80
Fluvanna.....	19.7	18.5	2.25	2.25	.44	.42
Franklin.....	11.4	12.4	4.80	4.80	.55	.60
Frederick.....	15.5	24.3	3.00	2.00	.47	.49
Giles.....	12.8	12.8	3.90	3.50	.50	.45

Source: Department of Taxation.

