

## 3

# TWIN COUNTIES STUDY UPDATE

**“The Impact of Highway Investments on Economic Growth in the Appalachian Region, 1969-2000: An Update and Extension of the Twin County Study”**

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## 3.1 Introduction

This chapter estimates the impacts of highway investments on economic growth in Appalachian counties between 1969 and 2000. The chapter has two objectives. The first objective is to update the 1995 study by Isserman and Rephann (I&R), which found statistically significant differences in economic growth rates of ARC counties when compared to their non-ARC counterparts in the 1965-1991 period, and that counties served by the Appalachian Development Highway System (ADHS) had even higher rates of income, population, and per capita income growth than otherwise similar (non-ARC) counties (1995; p.359). We extend this analysis to year 2000.

The second objective is to determine whether the amount, characteristics, and timing of ADHS investments can explain some of the differences in economic outcomes. In the Isserman and Rephann study, “ARC program variables are almost never statistically significant” (p.362), a finding we hypothesized might be due to the blunt measures of ARC program variables used in that study. To improve the quality of the highway investment variable, we surveyed state DOTs on the timing and characteristics of ADHS segments in their states, including construction start and end dates, section length, number of lanes, access type, number of signalized intersections, and number of interchanges. All thirteen ARC states participated fully in the survey process.

The critical empirical finding of this research is that (on average) the gap between ARC counties and their twins grew significantly in the 1990s. Relative to their non-ARC county twins, income in ARC counties had grown 131% more over the 1969 to 2000 interval; earnings growth was 96% higher; population growth was 9% higher; and per capita income was 36% higher. The performance of ARC counties with ADHS segments relative to their twins was even more impressive: income growth alone was over 200% higher for the 1969 to 2000 interval. The overall performance on the ARC region during this period, though, should not mask the struggles that pockets within ARC have experienced: performance in the northern part of the ARC

regions lagged its non-ARC twins and across the region, smaller metropolitan areas fell far behind their non-ARC counterparts.

The critical methodological finding from this chapter is that one reason top-down methodologies approaches have often failed to establish a link between highway investments and Appalachian development is poor measurement of highway investments. Using the improved highway measures afforded by our survey, we were able to establish a statistical link between ADHS investments and differential income and earnings growth between ARC counties and their twins.

We found that better measures of highway investment characteristics (e.g., new versus replacement investment; length of segment relative to county size) generated explanatory relationships that were statistically significant and robust, whereas poor measures of investment did not. This suggests that when characteristics of the proposed highway investments are properly measured, there is empirical support for claims that highway investments--here in the form of the ADHS investments--contribute to economic growth.

## 3.2 Appalachian Growth, 1969-2000

A key question for national policy makers and ARC members, partners, and staff concerns the effectiveness of different ARC programs on improving economic outcomes in Appalachia. Isserman and Rephann's 1995 study--which was subtitled "An Empirical Assessment of 26 Years of Regional Development Planning"--compared economic growth in Appalachian counties to growth in a control group of non-Appalachian counties ("twins"). The purpose of the control group is to proxy what would have otherwise occurred (in terms of growth) without ARC funding. The authors posit that once identified, the difference in the mean cumulative growth rates informs us whether there are real growth gains for the Appalachian county. To complete the study's objective, the authors attempted to identify the causal factors (through regression analysis) behind *significant* real growth differentials in favor of Appalachian counties.

Clearly then, much rests upon (a) the methods to select a non-Appalachian county twin, and (b) assessing how suitable each "match" is before advancing the growth analysis. The set of 391 non-Appalachian twin counties identified by Isserman and Rephann are used in our current update of their analysis which follows.

Eligible non-Appalachian counties for selection as a possible match were predicated on the following:

- The county's population centroid had to be at least 60 miles away from the Appalachian border
- Comparable growth in personal income, earning by sector over the period 1950-1959

- Comparable economic structure (earnings by sector) and population in 1959

Since a qualifying non-Appalachian county might provide a match to more than one Appalachian county, the final matching was guaranteed to reflect the optimal set by applying a distance weighting on the proposed pairs in the set of 391 Appalachian counties. The solution that had the minimum Mahalanobian distance<sup>11</sup> defined the optimal pair matches. The validity of the 391 match counties to serve ultimately as the “counter-factual” for Appalachian growth over the 1969-1991 period in the absence of ARC investments was confirmed statistically by the authors albeit with a slight bias.<sup>12</sup>

Isserman and Rephann (referred to here as “I &R”) found that on average, ARC counties outperformed their twins by significant margins over the 1969-1991 period: income and earnings growth in ARC counties was 48% higher (cumulatively) while per capita income growth was 17% higher. These differences were statistically significant (at the 10% level). The results were more ambiguous when county type was taken into account: large metropolitan (statistically insignificant however) and non-metropolitan counties (particularly those in the *Central* Appalachian subregion) fared much better than their twins, but smaller metropolitan areas (those with populations under 250,000) demonstrated a statistically significant finding of lower income, earnings, and per capita income growth than their twins. For non-metro areas, income, earnings, and per capita income differences were statistically significant.

These findings only reflect performance through 1991, neglecting the question of how ARC counties fared during the 1990s. To answer this question, we use the same data and the same control group as Isserman and Rephann (I&R). The data are from the U.S. Bureau of Economic Analysis and provide information on population, personal income by source, and earnings by industry by county for 1969-2000. These data, termed the “REIS” data,<sup>13</sup> provide a long time series and do not suffer from the data suppression issues that other potential data sources (e.g., County Business Patterns) do. We also use the same control group, namely the “twin county” matches developed by I&R and used in different studies of the Appalachian region.<sup>14</sup>

Exhibits 3-1, 3-2 and 3-3 provide the relevant data on ARC growth since 1969. Exhibit 3-1 reproduces the mean growth rate differences between Appalachian counties and their twins for the period 1969-1991 reported by I&R. Exhibit 3-2 presents updated estimates of the 1969-1991 mean growth rate differences using the most recent REIS data.<sup>15</sup> (The latter estimates are expected to differ from those of

<sup>11</sup> Mahalanobian distance accounts for correlations between variables, as discussed in Isserman & Rephann (1995)

<sup>12</sup> Over the 1950-1959 period the Appalachian counties exhibited a slightly more moderate rate of growth than the 391 non-Appalachian match counties – a manifestation that Appalachian counties pre-ARC investments (1965 inception) were uniquely disadvantaged locations. This bias would only serve to understate the role of ARC investments over 1969-1991 should significant, positive growth differentials be observed.

<sup>13</sup> “REIS” is the acronym for “Regional Economic Information System.”

<sup>14</sup> We thank Andrew Isserman for providing a list of the county matches used in Isserman and Rephann, 1995.

<sup>15</sup> REIS data used in this report were downloaded in late 2005.

I&R in Exhibit 3-1 because of changes in methods used in REIS, as well as the periodic updating of data sets by BEA.) Exhibit 3-3 presents mean growth rate differences between Appalachian counties and their twins for the 1969-2000 period.

Two matters stand out about the data. The first is that the more recent REIS data (shown in Exhibit 3-2) show a somewhat different picture of ARC performance for 1969-1991 than presented by I&R (shown in Exhibit 3-1). Both data sets show that ARC counties outperformed their twins across all measures in the 1969-1991 period; that certain characteristics (e.g., presence of ADHS segment) are associated with strong economic performance and others (e.g., metropolitan status with less than 250,000 in population) with weak performance; and great variability in performance of ARC counties by region and state. The more recent data, though, suggest that income growth was significantly higher in ARC counties than previously thought (68% higher than their twins between 1969 and 1991 compared to 48% in I&R); that the northern region of ARC outperformed its twins between 1969 and 1991; and the southern ARC region had more noticeably outperformed their twin counties with respect to income growth (aggregate and per capita) and earnings growth than originally measured.

**Exhibit 3-1. Isserman & Rephann's Reported Mean Growth Rate Differences, 1969-1991**

	<b>Income</b>	<b>Earnings</b>	<b>Population</b>	<b>Per Capita Income</b>	<b>Manufacturing</b>	<b>Retail Trade</b>	<b>Services</b>	<b>No. of Counties</b>
Appalachia	48%	48%	5%	17%	87%	67%	138%	<b>391</b>
Northern	-6%	-11%	-3%	7%	-76%	13%	46%	<b>143</b>
Central	101%	92%	7%	51%	427%	99%	131%	<b>86</b>
Southern	68%	78%	10%	8%	63%	99%	222%	<b>162</b>
Alabama	8%	33%	1%	-4%	94%	33%	127%	<b>35</b>
Georgia	199%	262%	35%	7%	101%	247%	689%	<b>35</b>
Kentucky	118%	105%	7%	68%	530%	112%	147%	<b>49</b>
Maryland	112%	95%	5%	72%	77%	173%	167%	<b>3</b>
Mississippi	27%	7%	7%	-17%	55%	60%	95%	<b>18</b>
New York	-2%	-3%	-2%	5%	1%	-4%	0%	<b>14</b>
North Carolina	53%	21%	0%	40%	-49%	101%	139%	<b>29</b>
Ohio	-11%	-2%	3%	-23%	-20%	-29%	36%	<b>28</b>
Pennsylvania	6%	-2%	-2%	16%	-70%	39%	58%	<b>52</b>
South Carolina	151%	130%	24%	12%	98%	191%	87%	<b>6</b>
Tennessee	68%	72%	10%	8%	277%	90%	119%	<b>50</b>
Virginia	36%	-18%	-3%	46%	191%	-38%	79%	<b>17</b>
West Virginia	-26%	-26%	-8%	15%	-179%	9%	22%	<b>55</b>
Metropolitan	50%	64%	8%	4%	110%	70%	205%	<b>95</b>
<250,000	-65%	-86%	-11%	-8%	-160%	-42%	-11%	<b>27</b>
Non-metro	48%	43%	4%	22%	80%	66%	115%	<b>296</b>
Appalachian HWY	69%	49%	6%	32%	61%	78%	92%	<b>110</b>
Interstate HWY	41%	48%	4%	15%	125%	70%	148%	<b>152</b>
Growth Center	37%	40%	4%	14%	101%	62%	85%	<b>90</b>
Coal Producing Distressed County	51%	41%	1%	38%	77%	47%	73%	<b>148</b>
	48%	31%	2%	28%	168%	55%	92%	<b>113</b>

Note: **Boldface** indicates significance at the 10 percent level.

**Exhibit 3-2. Recent REIS Data Calculated Mean Growth Rate Differences, 1969-1991**

	Income	Earnings	Population	Per Capita Income	MFG	Retail Trade	Services	No. of Counties
Appalachia	<b>68%</b>	<b>59%</b>	<b>6%</b>	<b>27%</b>	79%	<b>66%</b>	<b>170%</b>	<b>391</b>
Northern	<b>8%</b>	<b>3%</b>	-2%	<b>16%</b>	-85%	29%	<b>69%</b>	<b>143</b>
Central	<b>119%</b>	<b>89%</b>	<b>7%</b>	<b>57%</b>	<b>346%</b>	<b>69%</b>	<b>195%</b>	<b>84</b>
Southern	<b>94%</b>	<b>92%</b>	<b>11%</b>	<b>21%</b>	93%	<b>98%</b>	<b>248%</b>	<b>164</b>
Alabama	51%	56%	2%	22%	105%	44%	<b>179%</b>	<b>35</b>
Georgia	<b>221%</b>	<b>278%</b>	<b>38%</b>	9%	64%	<b>224%</b>	<b>741%</b>	<b>35</b>
Kentucky	<b>134%</b>	<b>96%</b>	<b>7%</b>	<b>61%</b>	517%	69%	<b>235%</b>	<b>49</b>
Maryland	110%	107%	5%	67%	129%	158%	248%	<b>3</b>
Mississippi	0%	-39%	5%	-26%	-1%	<b>55%</b>	9%	<b>18</b>
New York	6%	10%	-25%	-3%	-6%	14%	23%	<b>14</b>
North Carolina	<b>87%</b>	40%	-1%	<b>60%</b>	-32%	78%	126%	<b>29</b>
Ohio	8%	12%	2%	-3%	25%	2%	-36%	<b>28</b>
Pennsylvania	14%	6%	-1%	<b>20%</b>	<b>-65%</b>	<b>46%</b>	<b>78%</b>	<b>52</b>
South Carolina	<b>158%</b>	<b>148%</b>	<b>24%</b>	17%	<b>129%</b>	<b>196%</b>	12%	<b>6</b>
Tennessee	<b>113%</b>	<b>98%</b>	<b>11%</b>	<b>36%</b>	<b>257%</b>	<b>102%</b>	<b>167%</b>	<b>50</b>
Virginia	7%	-30%	-3%	25%	212%	-28%	110%	<b>17</b>
West Virginia	-2%	-3%	-6%	<b>26%</b>	<b>-225%</b>	23%	107%	<b>55</b>
Metropolitan	<b>84%</b>	<b>80%</b>	9%	<b>21%</b>	147%	71%	<b>198%</b>	<b>76</b>
<250,000	<b>-53%</b>	-57%	<b>-10%</b>	0%	-90%	-26%	63%	<b>31</b>
Non-metro	<b>62%</b>	<b>51%</b>	<b>4%</b>	<b>29%</b>	52%	<b>65%</b>	<b>160%</b>	<b>284</b>
Appalachian HWY	<b>92%</b>	<b>69%</b>	<b>7%</b>	<b>42%</b>	147%	<b>81%</b>	<b>194%</b>	<b>139</b>
Interstate HWY	<b>63%</b>	<b>60%</b>	5%	<b>27%</b>	125%	<b>69%</b>	<b>153%</b>	<b>162</b>
Growth Center	<b>79%</b>	<b>87%</b>	<b>8%</b>	<b>28%</b>	42%	<b>121%</b>	<b>175%</b>	<b>124</b>
Coal Producing Distressed County	<b>74%</b>	<b>67%</b>	3%	<b>40%</b>	93%	<b>53%</b>	<b>142%</b>	<b>134</b>
	<b>69%</b>	33%	3%	<b>40%</b>	139%	<b>48%</b>	<b>169%</b>	<b>115</b>

Note: **Boldface** indicates significance at the 10 percent level.

**Exhibit 3-3. Recent REIS Data Calculated Mean Growth Rate Differences, 1969-2000**

	Income	Earnings	Population	Per Capita Income	MFG	Retail Trade	Services	No. of Counties
Appalachia	<b>131%</b>	<b>96%</b>	<b>9%</b>	<b>36%</b>	132%	<b>127%</b>	<b>424%</b>	391
Northern	<b>-34%</b>	-48%	-5%	8%	-151%	0%	<b>77%</b>	143
Central	<b>191%</b>	<b>84%</b>	5%	<b>93%</b>	625%	<b>131%</b>	<b>387%</b>	84
Southern	<b>245%</b>	<b>228%</b>	<b>22%</b>	<b>31%</b>	146%	<b>236%</b>	<b>757%</b>	164
Alabama	4%	-33%	-1%	-5%	-35%	-31%	183%	35
Georgia	<b>780%</b>	<b>933%</b>	<b>79%</b>	<b>32%</b>	<b>583%</b>	670%	<b>2940%</b>	35
Kentucky	<b>205%</b>	79%	6%	<b>94%</b>	<b>1181%</b>	<b>128%</b>	<b>437%</b>	49
Maryland	160%	101%	4%	88%	-46%	123%	521%	3
Mississippi	34%	-12%	6%	-15%	-26%	<b>138%</b>	67%	18
New York	-54%	-47%	-8%	7%	-75%	-69%	19%	14
North Carolina	<b>194%</b>	70%	4%	<b>116%</b>	-166%	177%	356%	29
Ohio	-20%	-8%	-1%	-15%	-63%	-14%	-97%	28
Pennsylvania	-7%	-12%	-1%	15%	-130%	24%	46%	52
South Carolina	<b>308%</b>	<b>236%</b>	<b>34%</b>	15%	<b>149%</b>	<b>465%</b>	117%	6
Tennessee	<b>239%</b>	<b>134%</b>	<b>19%</b>	<b>54%</b>	203%	<b>249%</b>	<b>319%</b>	50
Virginia	-35%	-73%	-9%	44%	15%	-79%	205%	17
West Virginia	-80%	-98%	<b>-13%</b>	18%	<b>-265%</b>	-3%	174%	55
Metropolitan	<b>201%</b>	186%	17%	15%	146%	157%	<b>770%</b>	76
<250,000	<b>183%</b>	<b>-200%</b>	<b>-17%</b>	<b>-40%</b>	<b>-436%</b>	<b>-164%</b>	13%	31
Non-metro	<b>105%</b>	<b>62%</b>	<b>5%</b>	<b>44%</b>	127%	<b>116%</b>	<b>292%</b>	284
Appalachian HWY	<b>202%</b>	<b>117%</b>	<b>12%</b>	<b>63%</b>	96%	<b>163%</b>	<b>516%</b>	139
Interstate HWY	93%	117%	6%	<b>23%</b>	333%	108%	<b>426%</b>	162
Growth Center	<b>133%</b>	182%	9%	<b>40%</b>	102%	<b>229%</b>	<b>510%</b>	124
Coal Producing	<b>96%</b>	50%	1%	<b>54%</b>	92%	<b>70%</b>	<b>284%</b>	134
Distressed County	<b>96%</b>	3%	0%	<b>72%</b>	456%	<b>76%</b>	<b>250%</b>	115

Note: **Boldface** indicates significance at the 10 percent level.

The second noteworthy finding concerns the performance of ARC counties in the 1990s. As the data in Exhibit 3-3 show, by 2000, income in ARC counties had grown 131% more since 1969 than in the non-ARC counties; earnings growth was 96% higher; population growth was 9% higher; and per capita income was 36% higher. Mean growth rate differences (relative to twins) in counties with ADHS segments grew from 92% for the 1969-1991 period to 202% for the 1969-2000 period. At the same time, the 1990s saw the northern region of ARC fall behind its non-ARC counterparts; and income and earnings growth in the 31 smaller metropolitan counties (populations less than 250,000) dropped from about 50% less than their twins through 1991 to about 200% less than their twins by 2000.

The performances of individual states also varied widely, ranging from 80% less than the twins to 780% more. Interestingly, the states that performed best (and significantly so) relative to their twins (Georgia, Kentucky, and South Carolina) seemed to do so in part on the strength of their performances in manufacturing.

### 3.3 The Role of Highway Investments

By adopting the “twin county” approach, itself a version of the comparison group methodology, we share an important assumption with I&R: that differences in growth rates between ARC counties and their twins represent “what would have happened in Appalachia without the ARC,” i.e., without ARC programs. Although I&R were unable econometrically to establish a robust relationship between ARC programs (growth centers, distressed counties, and highway investments) and economic outcomes in Appalachian counties, it is possible that their results reflect poor measurement of program variables rather than weak program effectiveness. The poor quality of program measures is evident in the treatment of highways in their regression model: I&R roll ADHS and interstate highway investments into one binary variable (“Highway in County”), which takes a value of “1” if the county is home to at least 3 miles of ADHS or interstate and a “0” otherwise. The crudeness of this measure, we believed, might be the reason it was not possible to establish a statistical relationship between highway investments and economic growth.

To improve the quality of the highway investment variable, we surveyed state DOTs regarding the timing and characteristics of ADHS segments in their states, including construction start and end dates, section length, number of lanes, access type, number of signalized intersections, and number of interchanges. (A sample survey is presented at the end of this chapter.) Each of the 13 ARC states participated fully in the survey. Survey data were added to the REIS data on economic performance to create a dataset of highway investments and economic outcomes.

Before testing the new dataset for causal determinants of growth differentials between Appalachian counties and their twins, we attempt first to reproduce I&R’s findings for the 1969-1991 period, then extend their analysis to year 2000. The results are presented in Exhibit 3-4, which show reasonable consistency with I&R’s results. Specifically, for the analysis of income growth in ARC counties and their twins in the 1969-1991 period (“INC 91”), the two sets of findings are in accordance on the sign and significance of 14 of 18 of the variables used in the original I&R model specification. For the analysis of earnings growth (“EARN 91”), the analyses are also in accordance on 14 of the 18 variables. Some of the differences that do exist can likely be attributed to how the variables were constructed. (For example, the economic structure variables used in I&R are defined as the contribution of farm, manufacturing, retail, and government sectors to county total income in 1959, while this analysis used 1969 data because of issues of timing and data availability.) Others

are likely due to differences in old and new REIS estimates of earnings and income for this period.

Despite these differences, the current analysis reproduces the key finding of the original I&R analysis: that the presence of an interstate and/or ADHS highway segment cannot explain earnings or income growth patterns in ARC counties in the 1969-1991 period. (However, unlike the findings of I&R, the “highway” variable is positively and significantly correlated with per capita income, a finding that should be further explored in a later study.) These results also hold when the analysis is extended to examine the difference in income or earnings growth between 1969 and 2000 (“INC 00” and “EARN 00”).

**Exhibit 3-4. Regression Results Using Isserman and Rephann Specification**  
(*dependent variable is differential Income or Earnings growth by 1991 or 2000*)

<b>Explanatory Variable</b>	<b>INC 91</b>	<b>INC 00</b>	<b>EARN 91</b>	<b>EARN 00</b>
(Constant)	1.273	4.243	.645	1.269
South Region	<b>1.010</b>	<b>3.071</b>	<b>1.059</b>	<b>2.692</b>
Central Region	<b>1.154</b>	<b>2.308</b>	<b>1.019</b>	<b>1.630</b>
Distance to City of 25,000	<b>.014</b>	<b>.049</b>	<b>.015</b>	<b>.056</b>
Distance to City of 100,000	-.006	<b>-.023</b>	<b>-.008</b>	<b>-.023</b>
Distance to City of 250,000	-.003	<b>-.015</b>	<b>-.003</b>	<b>-.012</b>
Distressed Counties 1990	-.159	-.660	<b>-.663</b>	-1.187
Growth Center	-.108	-.596	-.059	-.217
Coal Producing	.313	.278	.443	.359
Mahalanobis Distance	<b>-.039</b>	-.078	-.004	-.011
Population Density, 1960	-.001	-.003	-.001	-.002
% Farm in Earnings, 1969	-.018	-.016	<b>-.038</b>	-.052
% Manu in Earnings, 1969	<b>-.026</b>	<b>-.080</b>	<b>-.026</b>	<b>-.062</b>
% Ret Trade in Earnings, 1969	-.001	.024	.025	.092
% FedGovCiv in Earnings, 1969	.025	-.041	.043	-.055
% FedMil in Earnings, 1969	-.090	-.282	-.079	-.199
% St/Local in Earnings, 1969	.014	.001	<b>.039</b>	.068
Population Growth Rate, 1950-60	<b>.022</b>	<b>.060</b>	<b>.021</b>	<b>.059</b>
ADHS or Interstate	.204	.641	-.079	.359

**Bold** indicates the regression coefficient is significant at the 10 percent level in both analyses;

**Bold italics** indicates variable is significant in current analysis but not in I&R analysis;

*Italics* indicates variable is significant in I&R but not in current analysis

For the second part of the analysis, we refined I&R’s single “highway” variable by decomposing it into its component parts, ADHS and interstate investments. Using a model specification that mimics the I&R model in all ways except that the “highway” variable is now disaggregated into separate “Interstate” and “ADHS” components, we

find that the presence of an ADHS segment in a county can in fact explain a portion of differential income growth for 1969-1991 (“INC 91”) and 1969-2000 (“INC 00”), as well as differential earnings growth in the 1969-2000 period (“EARN 00”). These results are presented in Exhibit 3-5.

**Exhibit 3-5. Regression Results Delineating Interstate and ADHS Investments**  
*( dependent variable is differential Income or Earnings growth by 1991 or 2000)*

<b>Explanatory Variable</b>	<b>INC 91</b>	<b>INC 00</b>	<b>EARN 91</b>	<b>EARN 00</b>
(Constant)	1.355	4.669	.600	1.365
South Region	<b>1.000</b>	<b>3.033</b>	<b>1.054</b>	<b>2.667</b>
Central Region	<b>1.129</b>	<b>2.210</b>	<b>1.009</b>	1.575
Distance to City of 25,000	<b>.013</b>	<b>.045</b>	<b>.015</b>	<b>.054</b>
Distance to City of 100,000	<b>-.008</b>	<b>-.028</b>	<b>-.009</b>	<b>-.027</b>
Distance to City of 250,000	-.003	<b>-.013</b>	-.002	<b>-.012</b>
Distressed County	-.149	-.627	-.654	-1.161
Growth Center	-.113	-.603	-.076	-.243
Coal Producing	.289	.209	.424	.294
Mahalanobis Distance	<b>-.040</b>	-.086	-.005	-.013
Population Density, 1960	-.001	-.003	-.001	-.002
% Farm in Earnings, 1969	-.017	-.015	<b>-.037</b>	-.051
% Manu in Earnings, 1969	-.025	<b>-.076</b>	<b>-.025</b>	<b>-.059</b>
% Ret Trade in Earnings, 1969	-.003	.017	.024	.087
% FedGovCiv in Earnings, 1969	.025	-.039	.044	-.055
% FedMil in Earnings, 1969	-.080	-.245	-.068	-.170
% St/Local in Earnings, 1969	.015	.005	<b>.041</b>	.072
Pop. ulation Growth Rate, 1950-60	<b>.022</b>	<b>.062</b>	.021	<b>.059</b>
Interstate	-.059	-.569	-.181	-.194
ADHS	<b>.421</b>	<b>1.552</b>	.207	<b>1.003</b>

***Bold** indicates the regression coefficient is significant at the 10 percent level*

To get yet a better measure of highway investments, in the third part of the analysis we use survey results to refine the “ADHS” variable to reflect the size (in lane-miles) of the segment relative to the size of the county; and the type of investment (new, widen, or replace) represented by each segment. These data were combined to produce estimates of lane-miles per county for 1991 and 2000, which were then refined by dividing by the land area in each county. This calculation yielded an estimate of the size of each type of ADHS segment relative to county size for 1991 and 2000.

Using these measures of highway investments confirms a relationship between ADHS investments and county-level income and earnings growth differentials relative to the non-ARC twin outcomes. However, as shown in Exhibit 3-6, the effect on earnings growth does not appear in the 1969-1991 growth rates but emerges for the 1969-2000 growth rates, supporting the hypothesis that business sector response to highway improvements is slower than the residential sector. (Note: income measures are by place of residence, earnings are by place of work.) This interpretation gets further support from the results in Exhibit 3-7, which show that when the highway investment variable refers to investments in place by 2000 (rather than those in place by 1991, as

in Exhibit 3-6), the impact on income and earnings growth is smaller.

**Exhibit 3-6. Results Using 1991 ADHS Segment Length Relative to County Size**  
(dependent variable is differential Income or Earnings growth by 1991 or 2000)

	INC 91	INC 00	EARN 91	EARN 00
(Constant)	1.397	4.631	.537	1.154
South Region	<b>1.019</b>	<b>3.123</b>	<b>1.033</b>	<b>2.664</b>
Central Region	<b>1.227</b>	<b>2.663</b>	<b>.978</b>	<b>1.703</b>
Distance to City of 25,000	<b>.013</b>	<b>.042</b>	<b>.015</b>	<b>.053</b>
Distance to City of 100,000	-.006	<b>-.022</b>	<b>-.008</b>	<b>-.023</b>
Distance to City of 250,000	-.003	<b>-.014</b>	-.002	<b>-.012</b>
Distressed Counties 1990	-.138	-.529	<b>-.642</b>	-1.075
Growth Center	-.094	-.520	-.083	-.213
Coal Producing	.407	.651	<b>.479</b>	.553
Mahalanobis Distance	<b>-.042</b>	-.092	-.006	-.015
Population Density, 1960	-.001	-.003	-.001	-.002
% Farm in Earnings, 1969	-.020	-.024	<b>-.037</b>	-.053
% Manu in Earnings, 1969	<b>-.026</b>	<b>-.078</b>	<b>-.024</b>	<b>-.058</b>
% Ret Trade in Earnings, 1969	-.004	.010	.026	.087
% FedGovCiv in Earnings, 1969	.026	-.035	.046	-.048
% FedMil in Earnings, 1969	-.085	-.240	-.066	-.157
% St/Local in Earnings, 1969	.011	-.006	<b>.039</b>	.067
Population Growth Rate, 1950-1960	<b>.023</b>	<b>.060</b>	<b>.021</b>	<b>.058</b>
Interstate	-.104	-.702	-.190	-.239
NewPerMileLandArea91	<b>4.550</b>	<b>22.146</b>	2.063	<b>14.249</b>
ReplacePerMileLandArea91	-2.125	-4.234	-2.204	-3.092
WidenPerMileLandArea91	-1.270	-5.317	2.334	2.987

The findings in Exhibit 3-6 also suggest that only some types of investments are likely to influence local economic activity. As the results in Table 6 show, the variable that measures lane miles of new highway construction (“NewPerMileLandArea91”) is positive and significant in the income and earnings growth equations for the 1969-2000 period. The variables for “replaced” and “widened” lane-miles per land area, however, are not significant for income or earnings in either period. The “NewPerMileLandArea91” variable is also significant in the 1969-1991 period for the income variable, although the effect is larger for the 1969-2000 period. Because the vast majority (80+ %) of lane-mile investments in place in 2000 were actually made pre-1991, these findings also suggest that there is a considerable lag between highway investments and their full effect on economic growth.

**Exhibit 3-7. Results Using 2000 ADHS Segment Length Relative to County Size**  
*(dependent variable is differential Income or Earnings growth by 2000)*

<b>Explanatory Variable</b>	<b>INC 00</b>	<b>EARN 00</b>
(Constant)	4.727	1.147
South Region	<b>3.037</b>	<b>2.588</b>
Central Region	<b>2.438</b>	1.532
Distance to City of 25,000	<b>.045</b>	<b>.055</b>
Distance to City of 100,000	<b>-.023</b>	<b>-.025</b>
Distance to City of 250,000	<b>-.014</b>	<b>-.012</b>
Distressed Counties 1990	-.509	-1.077
Growth Center	-.527	-.256
Coal Producing	.552	.422
Mahalanobis Distance	-.092	-.017
Population Density, 1960	-.003	-.002
% Farm in Earnings, 1969	-.022	-.049
% Manu in Earnings, 1969	<b>-.080</b>	<b>-.057</b>
% Ret Trade in Earnings, 1969	.024	.098
% FedGovCiv in Earnings, 1969	-.032	-.042
% FedMil in Earnings, 1969	-.260	-.164
% St/Local in Earnings, 1969	-.009	.071
Population Growth Rate, 1950-1960	<b>.068</b>	<b>.062</b>
Interstate	-.740	-.220
NewPerMileLandArea00	<b>14.783</b>	<b>9.148</b>
ReplacePerMileLandArea00	-5.474	-1.394
WidenPerMileLandArea00	-.832	8.422

### 3.4 Uses and Limitations of the Findings

Whereas the prior study examined Appalachian economic growth over the 1965-1991 period, this new study updates it to the year 2000. It confirms the general findings of the prior study that ARC is making a difference. The ARC counties are now outperforming comparable non-Appalachian counties in terms of income and earnings growth. It also confirms a general finding that economic performance is weaker and more problematic in the rural and micropolitan counties than in the larger metro counties.

However, this new expanded analysis adds information not previously available. This research effort included development of a large base of data on Appalachian Development Highway system mileage, lanes, and construction years, by county. Using this more detailed dataset, the new study found statistically significant evidence

that the completion and presence of an ADHS segment in a county does lead to greater economic growth. It found that “lane miles of new highway construction” (mostly built prior to 1990) is a significant predictor of income and earnings growth occurring later during the 1990s but not in earlier years. This indicates that the economic development impact of new highways can take many years to unfold. It also supports the finding that business sector response to highway improvements can be slower than the residential sector response. The study also found that “new construction,” but not “replacement” or “widening,” led to a notable impact on economic growth.

Beyond the highway impact, the study of long-term trends also showed that the states performing best relative to their non-Appalachian “twins” (i.e., Georgia, Kentucky, South Carolina, and Tennessee) appeared to do so in part on the strength of their performances in manufacturing. This reinforces the finding that manufacturing clusters are still an important source of economic growth.

This research effort shows the importance of continual updating and analysis of economic trends in Appalachian counties, as economic growth patterns continue to evolve in new ways. It also shows the need for further study to better untangle: (a) interactions of ADHS and interstate highway system improvements, (b) differential impacts of highway expansion and new construction, and (c) impacts on per capita income vs. growth of aggregate income and earning power (which also reflects population changes).

### **3.5 Survey Instrument**

The following three pages contain the survey letter and form. The survey was filled out by each of the thirteen state transportation departments, and provided information on Appalachian Development Highway sections in each state, including dates of construction of various highway sections, information on mileage, lanes, intersections, interchanges and traffic counts.



APPALACHIAN  
REGIONAL  
COMMISSION

*A Proud Past,  
A New Vision*

April 27, 2005

Mr. William Adams, P.E.  
Location Engineer  
Alabama Department of Transportation  
1409 Coliseum Boulevard  
Montgomery, AL 36110-3050

Dear Mr. Adams:

Staff of the Appalachian Regional Commission (ARC) and our consultants, Economic Development Research Group (EDRG), are conducting a study to measure economic development benefits of Appalachian Development Highways. The ARC is working to develop an updated historical inventory of prior projects for this study and for future use in demonstrating impacts of these projects.

We need help from each state to accomplish these goals. We ask that your agency help us to complete information shown on the next page, summarizing information on Appalachian Development Highway sections in your state, including dates of construction of various highway sections, information on intersections and interchanges and traffic count data. The enclosed packet includes an information collection form, a set of instructions, and a sample completed form. The information collection form lists each county in your state that has been identified as having at least one Appalachian Development Highway section. If you believe that this list contains any errors, please note it on the form or contact us directly.

If you have any questions about this project, please feel free to call Greg Bischak of the Appalachian Regional Commission at (202) 884-7790. If you have any questions about how to complete this form, please contact Teresa Lynch of EDRG at (617) 338-6775, ext. 207. Completed forms can be returned by email to [tlynch@edrgroup.com](mailto:tlynch@edrgroup.com) or by postal mail to EDRG, 2 Oliver St, 9<sup>th</sup> Floor, Boston MA 02114, attn: ADHS survey.

Thank you for your assistance.

Sincerely,

Kenneth Wester  
ADHS Program Coordinator

1666 CONNECTICUT AVENUE, NW, SUITE 700 WASHINGTON, DC 20009-1060 (202) 884-7760 FAX (202) 884-7691

Alabama      Kentucky      Mississippi      North Carolina      Pennsylvania      Tennessee      West Virginia  
Georgia      Maryland      New York      Ohio      South Carolina      Virginia

**INFORMATION COLLECTION FORM  
FOR DATABASE ON ADHS SEGMENTS**

**A. HIGHWAY SUMMARY**

State:	Alabama
Appalachian Corridor:	V, X
US/State Highway #s:	See attached map

Counties Served (list):	Franklin	Marion
	Jackson	Morgan
	Jefferson	St. Clair
	Lawrence	Walker
	Limestone	
	Madison	

**B. FORM COMPLETION**

Name of person completing the form:	Telephone number:
E-mail address:	Date of completion of the form:

**Instructions:**

The next page contains a form that asks for information about the characteristics of Appalachian highway sections within each county. The characteristics are: year construction started, year highway section was opened to traffic; highway width (number of lanes) before and after construction; type of highway improvement (brand new ("NEW"); widening of existing highway ("WIDEN"); or replacement of existing highway, which is then retired ("REPLACE")); and number of interchanges and signalized intersections. For interchanges and signalized intersections, the actual number should be entered; however, if the number is greater than 10, you may enter "10+". In cases where different highway sections within a county have different dates of construction or opening dates, information should be provided for each section separately. You might also wish to report multiple sections within each county if different parts of the highway have different roadway characteristics and/or different traffic levels.

In addition, we would like available traffic counts (average daily traffic totals, 2-way) for section of the highway route, ideally covering periods before completion, shortly after completion and most recently available. You may enter the traffic counts and other information on this form or use your own sheets. Please note the location of the counts if they apply only to a particular part of a highway section.

To aid in completion of this form, we have included a sample completed form and where available, maps that show segments alignments and route numbers.

