New Perspectives on Highway Investment and Economic Growth

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In challenging the idea that highway investment leads to economic growth, it was hypothesized that both highway investment and economic growth are related to a third variable: decentralization. To test this idea with 1980 and 1990 data from the county level in Florida, three working hypotheses were postulated: (a) economic growth is a function not of highway investment but of the population growth rate, (b) highway investment is a function of the population growth rate, and (c) traffic congestion growth is a function of initial traffic congestion, growth in road capacity, and population growth. Equations to test the three hypotheses were estimated with county-level data from Florida. Data included population, jobs, income, traffic, and road growth between 1980 and 1990. Overall, the results generally failed to support the idea that both income growth and highway growth are related to the variable decentralization. Income growth appears to be weakly related to suburbanization; growth of the state highway system does not. On the other hand, traffic congestion, road construction, or the endowment of the road system did not influence population or job growth or growth in total income. The endowment of the state highway system may have influenced the growth of earned income, however, perhaps by promoting greater interaction. The results strongly show that building more roads induces greater vehicular use, although doing so somewhat reduces the amount of traffic on each mile of state highway in the short term.

Economists and planners increasingly debate the effect of highway investment on economic growth. Some argue that congestion and increased vehicle wear contribute to the widely reported falling rate of productivity of the United States workforce. They argue that congestion and vehicle wear result from reduced levels of highway spending in relation to demand, an imbalance that has occurred since the late 1960s. Thus, massive road-building programs would end congestion, reduce vehicle wear, and restore U.S. competitiveness (*1–5*).

Others challenge such claims. Schultze (*6*) and Winston (*7*) argue that previous theses (*1,2,4,5*) arise from spurious correlations. The slowdown in the growth of U.S. productivity that began in the early 1970s most likely spurred a slowdown in road investment rather than the opposite. Areas that grow rapidly can afford to build more roads. They explain that although economic growth requires roads and other infrastructure, a society can build too many roads in the wrong places. After a certain level of investment, greater productivity growth would result from investments in other sectors of the economy. Appealing to arguments of previous investigators (*8,9*), these economists and planners argue that society should use road pricing to determine the optimal level and location of road investment. Moreover, road pricing could eliminate productivity losses resulting from congestion.

Although Winston (*7*) and Small et al. (*8*) believe that road pricing would point toward some increased road construction in certain areas, others argue that too much road construction has led to U.S. economic decline. The increasingly decentralized, automobile-dependent organization of American life is responsible for reduced productivity (*10*). Pucher (*11*) concludes that large subsidies encourage automobile use and the organization of land uses that go with it, making the alteration of travel behavior difficult to impossible. It can be inferred from these previous arguments that, although decentralization has continued at a rapid rate since the 1960s, its pace would have been even faster had highways been built at a faster rate. Thus, increased highway spending would worsen rather than improve U.S. productivity because it would increase the pace of decentralization and thus contribute to increased travel to accomplish the same objective.

This paper addresses the debate by examining primarily cross-sectional relationships between highway capacity, economic growth, and decentralization in Florida. Data come from the early and late 1980s, providing two time points. Our hypotheses derive from major arguments in the literature, which we summarize first.

LITERATURE

Using national time-series data, Aschauer (*1*) concluded that public investments in core infrastructure explain a significant amount of labor productivity. Highways, transit, and water and sewers constitute core infrastructure. Declines in core infrastructure since the late 1960s can account for much of the reduction in the growth of labor productivity in recent years. In later work, Aschauer (*2*) explicitly tested the impact of highway capacity, measured as centerline miles of road per square mile, and congestion, measured as vehicle registrations per centerline mile, on productivity, measured as the growth rate of income per capita. His data consisted of pooled time series and cross-sectional data for the various states. He found that road capacity explains a significant amount of the growth of real per-capita income.

Munnell (*4*) found results similar to those of Aschauer. Core infrastructure investment explains a significant amount of economic growth. In follow-up work (*5*), she explicitly examined the contributions of highway compared with water and sewer investments on economic growth. She concluded

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that both stimulated economic growth but that water and sewer investments tended to complement private investment in the economy, whereas highway investments tended to substitute for private investment.

Basing their arguments on compelling empirical evidence showing that the marginal cost of highway use far exceeds the average costs in congested or worn-out environments, several economists criticize Aschauer and Munnell, who assume that the marginal cost of road use is zero. Schultze (*6*) examined individual factors contributing to the growth of the U.S. economy, concluding that infrastructure investments play a relatively insignificant role. Efficient highway pricing would do much more to stimulate growth than blind investment in highways in areas of congestion or heavy wear. In making these arguments he relies on the work of transportation economists, particularly Small et al. (*8*), which in turn relies on theoretical work of Mohring (*9*) and others. These economists generally conclude that some additional highway investment in high-demand corridors would improve public welfare, but determining where investment would yield net benefits poses difficulties without efficient highway pricing. In most areas efficient highway pricing also would alleviate congestion more efficiently than capacity expansion would because expansion leads to increased driving and ultimately to the levels of congestion approaching those before the expansion.

Some policy analysts argue that inefficient road pricing leads to inefficient land uses and government expenditures. Pucher (*11*) cites work by Lee (*12*) in discussing large subsidies to the U.S. road system. Newman and Kenworthy (*10*) use empirical evidence to show that greater road investments promote additional driving, which more than compensates for less pollution and energy consumed per vehicle mile from free-flowing vehicles. Altshuler (*13*) argues that increased road capacity does not relieve congestion but promotes greater decentralization. Putman (*14*) uses mathematical models to show similar results. Schultze also dismissed the strong correlation between economic growth and core infrastructure investment found by Aschauer. Schultze suggested that both were related to exogenous variables changing over time rather than to each other directly.

HYPOTHESES

The results that Aschauer and Munnell present do not entirely support their arguments. Aschauer's results showed, surprisingly, that congestion also seems to explain part of the growth of productivity—that is, productivity grows faster in areas that are more congested than those that are not. Aschauer's theoretical position predicts such an occurrence only if highways are loaded below the bottleneck level. His results thus imply that highways are not loaded to the bottleneck level, meaning that they are not congested severely enough to depress economic growth. If this is so, then it also would appear that additional highway investment would not stimulate economic growth. Munnell suggests that highway investment drives out other forms of investment. These results and the arguments of critics lead us to suspect a spurious correlation between economic growth and highway investment that we test in this paper.

We suspect that population decentralization accounts for a spurious relationship between growth rate and highway density. As people and jobs migrate from older central cities, income rises in the low-density areas receiving the population. Part of the income growth derives from greater productivity of new capital investment. The same activity undertaken in a new plant is likely to be more productive than when undertaken in the old plant left behind. However, a good part of the growth may be illusory and is merely the relocation of economic activity from one geographic area to another.

At the same time, funding formulae for highways dictate that most funding goes to areas with the most vehicle miles traveled. Such funds can build more roads where urban activity is dispersed, such as in the suburban environments of the Sun Belt states. Thus, the greatest road construction goes on in the areas receiving the most migration.

Thus, we suspected a spurious correlation between economic growth and centerline-mile density. Growth in both variables likely resulted from a third variable, which is population growth. We explore this idea by testing two hypotheses:

1. Economic growth is a function of population growth and is not related to highway investment; and
2. Highway investment is a function of population growth.

We also developed a third, related, hypothesis: road construction does not reduce traffic congestion. The third hypothesis is based on the idea that in congested environments the construction of new roads merely allows more travel to take place.

METHODS

We tested the three hypotheses in one state—Florida—with the use of county data on population, jobs, income, traffic, and road growth between 1980 and 1990. Data sources include the Florida Department of Transportation (FDOT), which compiles at the county level statistics on various categories of state highways, including centerline miles, lane miles, and vehicle miles traveled. The FDOT also made records available to us from which we tabulated lane miles of all roads in each county. The *Florida Statistical Abstract* yielded information on population and jobs.

We first tested the hypothesis that growth in real per-capita income between 1980 and 1990 was related to population and job growth more than to the presence of road capacity. We estimate two models:

$$\begin{aligned}\text{GIPC} = {} & b_1 + b_2 * \text{IPC80} + b_3 * \text{AREA} \\ & + b_4 * \text{POPD80} + b_5 * \text{BEACH} \\ & + b_6 * \text{SUBDUM} + b_7 * \text{TRAF80} \\ & + b_8 * \text{GPOP} + b_9 * \text{GJOBS} \\ & + b_{10} * \text{LMD80} + b_{11} * \text{GLMD} \\ & + b_{12} * \text{TLMD80} + b_{13} * \text{GTLMD} \qquad (1)\end{aligned}$$

where

GIPC = growth in real county per-capita income between 1980 and 1989;
IPC80 = per-capita income in 1980;
AREA = area of county (mi^2);
POPD80 = population density of county ($people/mi^2$);
BEACH = dummy variable denoting whether county has sandy ocean or gulf beach frontage;
SUBDUM = dummy variable denoting whether county is adjacent or bedroom to traditional urban counties of Dade, Hillsborough, Pinellas, Orange, Duval, and Escambia;
TRAF80 = state highway traffic congestion in 1980 (daily vehicle-mi traveled on state highways/lane-mi of state highway);
GPOP = population growth rate by county between 1980 and 1989;
GJOBS = county job growth rate;
LMD80 = density of state highways in county in 1980 (lane mi/mi^2 of county);
TLMD80 = similar measure for all state and local roads;
GLMD = growth rate in size of state highway system between 1980 and 1990; and
GTLMD = growth rate of entire road system over same period.

Equation 1 is similar to the Aschauer model, except that we use one time period and we include measures of growth.

We also reestimated Equation 1 with a different measure of income:

$$\begin{aligned} \text{GRIPC} = {} & b_1 + b_2 * \text{RIPC80} + b_3 * \text{AREA} \\ & + b_4 * \text{POPD80} + b_5 * \text{BEACH} \\ & + b_6 * \text{SUBDUM} + b_7 * \text{TRAF80} \\ & + b_8 * \text{GPOP} + b_9 * \text{GJOBS} \\ & + b_{10} * \text{LMD80} + b_{11} * \text{GLMD} \\ & + b_{12} * \text{TLMD80} + b_{13} * \text{GTLMD} \end{aligned} \tag{2}$$

where GRIPC is the growth between 1980 and 1990 of earned income (total income less transfer payments, interest, and dividends). We deflated earned income with the consumer price index and the index of price variation between Florida counties for 1980 and 1990. RIPC80 is real earned income per capita in 1980.

Finally, we explained growth rates in county population and county jobs with the following equations:

$$\begin{aligned} \text{GPOP} = {} & b_1 + b_2 * \text{POPD80} + b_3 * \text{AREA} \\ & + b_4 * \text{RIPC80} + b_5 * \text{TRAF80} \\ & + b_6 * \text{LMD80} + b_7 * \text{TLMD80} \\ & + b_8 * \text{GLMD} + b_9 * \text{GTLMD} \\ & + b_{10} * \text{SUBDUM} + b_{11} * \text{BEACH} \\ & + b_{12} * \text{GJOBS} \end{aligned} \tag{3}$$

and

$$\begin{aligned} \text{GJOBS} = {} & b_1 + b_2 * \text{JOBD80} + b_3 * \text{AREA} \\ & + b_4 * \text{RIPC80} + b_5 * \text{TRAF80} \\ & + b_6 * \text{LMD80} + b_7 * \text{TLMD80} \\ & + b_8 * \text{GLMD} + b_9 * \text{GTLMD} \\ & + b_{10} * \text{SUBDUM} + b_{11} * \text{BEACH} \\ & + b_{12} * \text{GPOP} \end{aligned} \tag{4}$$

In testing the second hypothesis we estimated an equation explaining the growth in density of state highway lane miles:

$$\begin{aligned} \text{GLMD} = {} & b_0 + b_1 * \text{LMD80} + b_2 * \text{TLMD80} \\ & + b_3 * \text{AREA} + b_4 * \text{POPD80} \\ & + b_5 * \text{RIPC80} + b_6 * \text{GJOBS} \\ & + b_7 * \text{GPOP} + b_8 * \text{BEACH} \\ & + b_9 * \text{SUBDUM} + b_{10} * \text{TRAF80} \\ & + b_{11} * \text{GTLMD} + b_{12} * \text{GVMD} \end{aligned} \tag{5}$$

where

GLMD = growth rate in state highway lane-mile density in each county between 1980 and 1989;
POP80 = county population in 1980;
VMD89 = state vehicle miles traveled per square mile of county; and
LMD89 = state highway lane-mile density in 1989.

In testing the third hypothesis, we estimated two equations. Equation 6 explains the growth in traffic congestion, whereas Equation 7 explains growth in vehicle miles traveled. In Equation 6

$$\begin{aligned} \text{GTRAF} = {} & b_0 + b_1 * \text{VMD80} + b_2 * \text{POPD80} \\ & + b_3 * \text{GPOP} + b_4 * \text{GJOBS} \\ & + b_5 * \text{GRIPC} + b_6 * \text{LMD80} \\ & + b_7 * \text{GLMD} + b_8 * \text{TLMD80} \\ & + b_9 * \text{GTLMD} + b_{10} * \text{BEACH} \\ & + b_{11} * \text{SUBDUM} \end{aligned} \tag{6}$$

where

GTRAF = growth rate in state highway traffic congestion (daily vehicle-mi/lane-mi of state highway) between 1980 and 1989;
VMD80 = vehicle-mile density in 1980 (state highway vehicle-mi ÷ county area);
GLMD = growth rate in state lane-mile density in each county; and

GTLMD = growth rate in total lane-mile density in each county.

In Equation 7

$$
\begin{aligned}
GVMD = {} & b_0 + b_1 * VMD80 + b_2 * POPD80 \\
& + b_3 * GPOP + b_4 * GJOBS \\
& + b_5 * TRAF80 + b_6 * AREA \\
& + b_7 * LMD80 + b_8 * GLMD \\
& + b_9 * TLMD80 + b_{10} * GTLMD \\
& + b_{11} * BEACH + b_{12} * SUBDUM \\
& + b_{13} * GRIPC \qquad (7)
\end{aligned}
$$

where GVMD is the growth rate of daily vehicle-mile density in a county on the state highway system.

Table 1 presents a description of the variables used in the study, and Table 2 presents correlations.

TABLE 1 Data Summary: 67 Cases

Variable	Mean	S.D.	Maximum	Minimum
RIPC80	5575.143	1369.725	9157.227	3079.103
AREA	809.731	395.260	2054.000	240.000
POPD80	0.182	0.375	2.758	0.005
JOBD80	0.074	0.153	1.057	0.001
BEACH	0.388	0.491	1.000	0.000
SUBDUM	0.194	0.398	1.000	0.000
TRAF80	2.813	1.764	8.656	0.726
GPOP	0.353	0.211	1.182	0.029
GJOBS	0.573	0.333	1.412	0.000
LMD80	0.620	0.444	3.311	0.141
TLMD80	4.044	3.990	30.670	0.772
GLMD	0.075	0.182	0.740	-0.152
VMD80	2.218	3.310	23.004	0.015
GTLMD	0.183	0.343	2.118	-0.160
GVMD	0.567	0.246	1.238	0.104
DVM	0.063	0.166	0.933	0.000

RESULTS

Tables 3 through 6 present the results of estimating Equations 1 through 4. Table 3 (Equation 1) only weakly explains total income growth, with growth in jobs (GJOBS), the initial level of income, and the suburban dummy variable (SUBDUM) having the greatest explanatory power. Population growth (GPOP) has no explanatory power; neither does traffic (TRAF80) or the endowment of roads (TLMD80 and LMD80) or the growth rates in roads (GLMD and GTLMD). Table 4 (Equation 2) shows similar results in explaining the growth of earned income, except that the endowment of the state highway system is significant in explaining county earned-income growth at the 10 percent level. Although the standard error for the coefficient is relatively high, the estimated coefficient yields an elasticity of income growth with respect to the endowment of state highway lane miles of somewhat less than 1. Tables 5 and 6, explaining GJOBS and GPOP, show that traffic congestion, the suburban and beach dummy variables, the road endowment variables, and the road growth variables have little explanatory power. Together the four equations weakly support Hypothesis 1—that income growth is related to suburbanization and not road construction. Except in one instance, road variables have little explanatory power in explaining growth in total income, jobs, or population. Traffic congestion appears to have no impact on any of these growth rates. The endowment of the state highway system, however, may have some power explaining growth in earned income.

Table 7 shows the estimate of Equation 5. The table shows that growth in state highway lane miles took place primarily where traffic was heavier in 1980, where traffic grew the most rapidly, where the endowment of state highway lane miles was weaker in 1980, and in beach areas. Neither the growth rate in population or jobs nor the suburban dummy variable (SUBDUM) had much of an impact on growth in state highway lane miles. These results show that the supply of state highway facilities was not related to growth rates in population or jobs, disproving the second hypothesis.

Tables 8 and 9 present the estimation of Equations 6 and 7, respectively, and speak to the third hypothesis that road construction does not reduce congestion but instead induces greater amounts of driving. The tables suggest that the first hypothesis is wrong, at least in the short term, but that the second hypothesis is true. Expansion of the state highway system did slow the rate of congestion in the short term, but it also induced greater volumes of travel. Looking at Table 8 we see that the greater the vehicle-mile density in 1980, the less congestion grew over the next 10-year period. State highway construction over the same 10 years mitigated the growth of congestion, whereas growth in total lane-mile density had

TABLE 2 Correlation Matrix

	RIPC80	AREA	POPD80	JOBD80	BEACH	SUBDU	TRAF80	GPOP	GJOBS	LMD80	TLMD80	GLMD	VMD80	GTLMD	GVMD
RIPC80	1.00	0.37	0.34	0.42	0.23	0.13	0.56	-0.04	-0.15	0.37	0.24	0.35	0.41	0.01	0.040
AREA		1.00	-0.00	0.06	0.14	0.24	0.31	0.08	0.00	-0.11	-0.14	0.21	0.01	-0.01	0.065
POPD80			1.00	0.99	0.33	0.06	0.70	-0.13	0.04	0.89	0.94	0.36	0.97	-0.01	-0.069
JOBD80				1.00	0.33	0.01	0.74	-0.15	0.00	0.90	0.91	0.39	0.98	-0.02	-0.060
BEACH					1.00	0.23	0.38	0.21	0.25	0.29	0.31	0.53	0.31	0.11	0.445
SUBDUM						1.00	0.30	0.12	0.23	0.03	0.00	0.12	0.07	0.04	0.028
TRAF80							1.00	0.05	0.14	0.61	0.62	0.65	0.76	-0.03	0.098
GPOP								1.00	0.61	-0.10	-0.08	0.03	-0.10	0.41	0.268
GJOBS									1.00	0.02	0.10	0.10	0.03	0.30	0.271
LMD80										1.00	0.88	0.20	0.94	0.01	-0.032
TLMD80											1.00	0.30	0.91	-0.08	-0.005
GLMD												1.00	0.34	0.30	0.488
VMD80													1.00	-0.01	-0.095
GTLMD														1.00	0.096
GVMD															1.000

TABLE 3 Growth in Real Per-Capita Total Income

VARIABLE	COEFFICIENT	T-STAT.
C	0.54194	4.80646
IPC80	-0.04003	-2.49325
AREA	-0.00001	-0.11169
POPD80	0.18074	0.95192
BEACH	0.03829	0.76600
SUBDUM	0.10825	2.10500
TRAF80	-0.02068	-0.92454
GPOP	-0.07492	-0.55289
GJOBS	0.22892	3.03368
LMD80	-0.01744	-0.15525
GLMD	0.22259	1.15965
TLMD80	-0.00811	-0.49216
GTLMD	-0.02584	-0.39107
R-squared		0.35808
Adjusted R-squared		0.21543
F-statistic		2.51021

TABLE 6 Population Growth Rate

VARIABLE	COEFFICIENT	T-STAT.
C	-0.00796	-0.06681
POPD80	-0.37706	-1.86956
AREA	0.00006	0.96198
RIPC80	0.00000	0.12765
TRAF80	0.01981	0.78476
LMD80	0.00295	0.02390
GLMD	-0.11598	-0.63784
TLMD80	0.02274	1.28091
GTLMD	0.18971	2.79873
SUBDUM	0.01564	0.27897
BEACH	0.04352	0.82688
GJOBS	0.29236	3.94189
R-squared		0.498973
Adjusted R-squared		0.398767
F-statistic		4.979499

TABLE 4 Growth in Real Per-Capita Earned Income

VARIABLE	COEFFICIENT	T-STAT.
C	0.40410	2.61491
RIPC80	-0.00006	-2.32519
AREA	-0.00000	-0.04832
POPD80	0.00205	0.00759
BEACH	0.05780	0.84191
SUBDUM	0.20064	2.75878
TRAF80	-0.01997	-0.60676
GPOP	-0.11583	-0.66267
GJOBS	0.22356	2.05319
LMD80	0.28015	1.75033
GLMD	-0.00621	-0.02624
TLMD80	-0.01782	-0.76307
GTLMD	-0.14659	-1.56082
R-squared		0.360166
Adjusted R-squared		0.217980
F-statistic		2.533060

TABLE 7 Growth in Lane-Mile Density

VARIABLE	COEFFICIENT	T-STAT.
C	-0.10686	-1.39549
LMD80	-0.27469	-3.85851
TLMD80	-0.00406	-0.35742
AREA	-0.00007	-1.64245
POPD80	0.22970	1.71649
RIPC80	0.00001	0.46938
GPOP	-0.07587	-0.90489
GJOBS	-0.04427	-0.84346
BEACH	0.07259	2.25842
SUBDUM	-0.02006	-0.57474
TRAF80	0.07474	5.77836
GTLMD	-0.00330	-0.07290
GVMD	0.29502	4.81128
R-squared		0.743714
Adjusted R-squared		0.686762
F-statistic		13.05854

TABLE 5 Job Growth Rate

VARIABLE	COEFFICIENT	T-STAT.
C	0.41723	2.04472
JOBD80	-0.45911	-0.55374
AREA	0.00001	0.08054
RIPC80	-0.00006	-1.86766
TRAF80	0.04538	1.10925
LMD80	-0.10586	-0.49795
TLMD80	0.02936	1.15772
GLMD	-0.10530	-0.35592
GTLMD	0.11812	1.03536
SUBDUM	0.08893	0.96659
BEACH	0.07837	0.92550
GPOP	0.76217	3.94354
R-squared		0.479059
Adjusted R-squared		0.374870
F-statistic		4.598009

TABLE 8 Growth in Traffic

VARIABLE	COEFFICIENT	T-STAT.
C	0.23615	3.28854
VMD80	-0.13909	-3.29714
POPD80	0.30081	0.92077
GPOP	0.15863	1.15443
GJOBS	0.02999	0.34189
GRIPC	0.16789	1.67139
LMD80	0.60526	3.35681
GLMD	-0.35690	-2.31062
TLMD80	0.00544	0.30831
GTLMD	0.01993	0.27566
BEACH	0.04858	0.89102
SUBDUM	-0.05076	-0.87405
R-squared		0.554720
Adjusted R-squared		0.465664
F-statistic		6.228894

TABLE 9 Growth in Vehicle-Mile Density

VARIABLE	COEFFICIENT	T-STAT.
C	0.06027	0.52841
VMD80	-0.19361	-3.42050
POPD80	0.39477	1.07586
GPOP	0.14734	1.04761
GJOBS	0.03057	0.34122
TRAF80	0.01675	0.50285
AREA	0.00008	1.15677
LMD80	0.81384	4.06194
GLMD	0.89035	4.61408
TLMD80	0.01397	0.73454
GTLMD	0.04799	0.62467
BEACH	0.04825	0.86495
SUBDUM	-0.07784	-1.22199
GRIPC	0.19454	1.86752
R-squared		0.617919
Adjusted R-squared		0.524201
F-statistic		6.593382

no impact on traffic congestion of the state highway system. Table 9 shows that the endowment of the state highway system in 1980 had a great impact on stimulating growth in total driving, whereas the growth rate in highway construction between 1980 and 1990 had an even greater impact. The magnitude of vehicle-mile density in 1980 significantly depressed further traffic growth.

CONCLUSIONS

In challenging the idea that highway investment leads to economic growth, we hypothesized that both highway investment and economic growth are related to a third variable: decentralization. To test this idea with 1980 and 1990 data from the county level in Florida, we postulated three working hypotheses:

1. Economic growth is not a function of highway investment but is a function of the population growth rate;
2. Highway investment is a function of the population growth rate; and,
3. Traffic congestion growth is a function of initial traffic congestion, growth in road capacity, and population growth.

Our results generally confirm the first hypothesis, although this statement is qualified by the definition of real income growth per capita. If income growth is defined as the growth of total income per capita, including transfer and investment income, its growth was not influenced by highway investment at the 1, 5, or 10 percent levels of significance. Although population growth rate also had no effect on the growth of total real per capita income, job growth rate did, as did a dummy variable denoting suburbanization.

On the other hand, if income growth is defined as real earned income per capita (no transfer or investment income included), highway investment had no impact on its growth at the 1 and 5 percent significance levels, but it did at the 10 percent level. Highway investment may have some impact on worker productivity, but the growth rate in jobs and the suburbanization dummy variable had greater explanatory power. We also found that highway investment had no explanatory power in the job or population growth rates of counties.

Our results disprove the second hypothesis, if highway investment is defined as the growth in state highway lane miles per square mile. The magnitude of traffic congestion and the growth rate in vehicle miles per square mile had the greatest explanatory power in the growth rate of state highway lane mile density; population and job growth rates had no explanatory power. However, the population growth rate does partly explain the growth rate in total highway lane mile density, which consists mostly of access roads.

In regard to the third hypothesis, we found that the greater the magnitude of driving per square mile in 1980, the less traffic grew on each mile of road. This confirmed part of our hypothesis. We also found that the greater the extent of the state highway road system in 1980, the greater the growth rate in traffic congestion. On the other hand, construction of additional highway capacity between 1980 and 1990 reduced the growth rate of the volume of traffic on each mile of state highway, which is a finding contrary to our hypothesis. Overall, however, adding miles of state highways stimulated additional driving.

Overall, the results generally fail to support the idea that both income growth and highway growth are related to decentralization. Income growth appears weakly related to suburbanization; growth of the state highway system does not. It is more influenced by the magnitude of road use and the growth of road use. Although both road use and the growth of road use may be greatest in areas that are undergoing suburbanization, most of the variables that we used to identify decentralization (GPOP, GJOBS, SUBDUM, and BEACH) do not support this notion. Only BEACH had a significant effect on explaining the growth of state highway lane miles.

On the other hand, neither traffic congestion, road construction, nor the endowment of the road system influenced population or job growth or growth in total income. The endowment of the state highway system may have influenced the growth of earned income, however—perhaps by promoting greater interaction. The results strongly show that building more roads induces greater vehicular use, although doing so reduces somewhat the amount of traffic on each mile of state highway in the short term.

Our results show little support for the idea that road construction leads to economic growth. This is not counter-intuitive: although transportation investment clearly is important to economic growth, it has diminishing returns. Early canals and railroads stimulated economic growth because their introduction into regions without improved transportation had a huge impact on regional accessibility. On the other hand, most regions today enjoy an abundance of improved transportation facilities. The addition of a new road further improves regional accessibility only marginally and may not be worth the well-documented direct and indirect costs associated with road construction, operation, and maintenance. It is possible that a society could have too many highways rather than too few. Another view is that more roads promote the proliferation of low-value, unproductive travel. The demand for low-value travel may be elastic, which means that little of it occurs when prices are high but lots of it occurs when prices are low, as in the U.S. context. The congestion that this type of travel causes unfortunately impedes high-value, productive travel, whose demand is inelastic. Because prices have little impact on high-value travel, increased road construction will not stimulate it very much. Instead, increased road construction would stimulate large increases in unproductive travel and the dispersed land uses that go with such travel. Although severe congestion may depress economic growth (although our aggregate results do not suggest this, as shown in Tables 3 and 4), severe congestion costs nothing with respect to capital outlay or destroyed neighborhoods, and it restricts growth in vehicle miles traveled, thus restricting growth in energy consumption and pollution. Expanding road capacity has the opposite effect. Only where it can be demonstrated that severe congestion depresses economic growth could road expansion be justified and then only if benefits outweighed costs. Cost-benefit analyses or efficient road pricing could determine when such conditions were met.

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Publication of this paper sponsored by Committee on Transportation Economics.