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Comprehensive Analysis of New highways as economic development tools

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ABSTRACT

In this paper, the author has studied about various aspects of highways in India as economic tools. The continuing appeal of highways as regional economic development tools might give the impression that there is substantial agreement about their likely regional economic effects, but three contentious groups exist. The first consists primarily of citizens of declining rural communities, government officials, and producers of highway related goods and services.

Keywords: transportation, regional development policy, statistical methods (JEL Codes: R40, R58).

INTRODUCTION

Approximately three decades ago the U.S. Congress and President embarked on a plan to develop one of America's most persistently lagging regions. The Appalachian Redevelopment Act, signed in 1965 by President Lyndon Johnson, created the Appalachian Regional Commission (ARC). It was assigned the task of improving Appalachia's basic economic and social infrastructure and developing its human and natural resources. The Commission had broad-based goals and a comprehensive regional development philosophy, but 65% of the program's initial expenditures were assigned to highway construction. This highways emphasis was justified by language contained in an earlier recommendation forwarded to the President. According to the President's Appalachian Commission (1964), "penetration by an adequate transportation network" was the biggest obstacle to the region's future economic development. Although regional economic development has been the cornerstone of few federal highway initiatives since then (Rephann 1993a), the late 1980s and early 1990s witnessed increased interest in infrastructurebased development strategies.

Investment in state road infrastructure figured prominently among these, and several states embarked on sizable highway construction and rehabilitation programs, including provisions for assisting the development of lagging and rural intra-state regions (Johnson 1989; Forkenbrock et al. 1990). In response to both this revival of state interest and publicity surrounding numerous bridge collapses, traffic gridlock, and the San Francisco earthquake disaster, new comprehensive federal legislation passed in 1991. The Intermodal Surface Transportation Efficiency Act designated a 155,000 mile national highway system composed of interstate highways and primary arterial roads. As in debates past and present, regional and rural economic development were invoked during Congressional hearings as reasons for adopting the legislation.

The continuing appeal of highways as regional economic development tools might give the impression that there is substantial agreement about their likely regional economic effects, but three contentious groups exist. The first consists primarily of citizens of declining rural communities, government officials, and producers of highway related goods and services. They argue that new highways create broad economic growth and development along the highway routes (see ARC 1982 for an example). The second group argues that "highways are necessary but not sufficient for economic growth and development" (Huddleston and Pangotra 1990; Sears et al. 1990). This group includes growth center proponents who argue that new highway construction may help to reinforce urban areas along a route and may eventually spread growth to peripheral lagging regions (Hansen 1966; Newman 1972). The third group consists of critics who charge that developmental highway construction has little merit because such investment is economically inefficient, theoretically unjustified, and empirically unsubstantiated (Caudill 1969; Munro 1969; Manuel 1971; Wright and Blase 1971; Lord 1972; Hale and Walters 1974; Waters 1980).

Much speculation has been offered about the likely effect of new highway construction on rural economic growth (e.g., Hansen 1966; Caudill 1969; Munro 1969; Gauthier 1970; Manuel 1971; Newman 1972; Straszheim 1972; ARC 1982; Hale and Walters 1974; Siccardi 1986; Gillis 1989; Huddleston and Pangotra 1990; Sears et al. 1990), but few comprehensive empirical studies exist. The objective of this paper is to begin to fill the empirical gaps. To this end, the spatial and economic consequences of new interstate highways in rural areas during construction and after construction

are examined. Counties that received interstate highways built during the 1960s and early 1970s and counties off the interstate system are studied for clues about the spatial and industrial pattern of effects. Of particular interest are the economic effects of these new highways during the post-construction period on nonmetropolitan cities, the urban fringe, more spatially isolated rural areas, and nearby off-interstate counties. This information will be used to understand the spatial contexts in which interstate highways stimulate economic growth and the characteristics of the resulting growth. It will also provide some insight into development patterns within rural areas, particularly the relationship between rural cities and their hinterlands.

HIGHWAYS AND ECONOMIC GROWTH

The relationship between highway investment and regional economic growth is a complex one, not easily summarized by appealing to one regional economic theory or another. A reason for the complexity is that transportation infrastructure has both spatial and economic properties. On the one hand, transportation infrastructure has "network properties" (Rietveld 1989), meaning it has the extraordinary ability to shift market areas and affect communication channels. On the other hand, it is an input into the production of private and public sector goods. Therefore, it affects the socioeconomic landscape in ways that no single location model (e.g., von Thünen, Weber, Hoover) can fully anticipate. In order to be tractable, these models assume industrial linkages and transportation structures pertinent to particular types of industries and, therefore, their results cannot be generalized to all industries (Paelinck and Nijkamp 1975). Highway investment also affects household location decisions. Residential choices are affected by the costs of commuting, which are lowered by new highways. These residential choices may, in turn, influence the location decisions of firms and industries.

Temporal effects

Researchers normally divide the study period into construction and post-construction stages when investigating the temporal effects of highway investment. Construction expenditures made locally stimulate the region during the highway construction phase. Construction and engineering firms employ local labor and purchase local building supplies, which have multiplicative effects on the regional economy. The magnitude of these multiplier effects depend on the extent of interindustry linkages, interregional leakages, the size of construction expenditures, and the size of highway displacement effects. The duration and timing of post-construction economic effects are more difficult to assess. Most studies have confined their evaluation periods to two decades or less. One view is that the effects are immediate "and continue to influence the level and distribution of economic activity over a long period of time" (Gaegler et al. 1979). Another view is that the economic effects of highways are realized after a lag of several years (Munro 1966). Lags between four and seven years have been estimated empirically (Wilson et al. 1986; Burress et al. 1989).

Industrial effects

The industrial distribution of highway effects varies from the construction to post-construction stages. During the construction stage, a region experiences an exogenous boost in construction expenditures, which is sustained over a few years until the project is completed. These effects can be highlighted by considering two input output models: that of the United States and West Virginia, a predominantly rural state.1 These models can illustrate the effect of each dollar change in demand for new highway and street construction (SIC code 1611) on output by industry. As figure 1 shows, the primary sectors such as construction (CON) and manufacturing (MFG) are stimulated most. Tertiary sectors such as services (SVC), trade (TRD), finance, insurance, and real estate (FIR), and transportation and public utilities (TPU) follow. Government (GVT), farming (FAR), and agricultural services (AGS) are least affected. The large disparity in the mining (MIN) effects is probably caused by the availability of construction material, including stone, gravel, sand, and asphalt. Inputs provided to West Virginia by out-of-state suppliers explain the large divergence in import purchases between the United States (0.01) and West Virginia (0.51). Thus, the degree of openness of a particular region and its industrial structure can result in substantial differences in highway construction impacts.

Interstate highways seem to have their greatest effect on marketoriented industries and interstate traffic related industries (Lichter and Fuguitt 1980; Briggs 1980; Isserman et al. 1989). The short-haul transportation cost reductions associated with improved highway service tend to re-draw trade and service boundaries in favor of highway counties (Kuehn and West 1971; Briggs 1980; Blum 1982). Furthermore, increased through traffic can create additional demand for non-local travel and tourism services (Lichter and Fuguitt 1980). Some studies found negligible manufacturing effects (Kuehn and West 1971; Lichter and Fuguitt 1980; Briggs 1980), but others focusing on urban areas found manufacturing is stimulated (Wheat 1969; Stephanedes and Eagle 1986; Eagle and Stephanedes 1988; Isserman et al. 1989).

METHODS AND DATA

Economic development is a function of a variety of costs and production factors, including transportation. The literature highlighted several of these factors. The most notable one were market size, localization and urbanization economies, local costs factors, labor cost qualifications, the business cycles, and transportation accessibility among others. This paper holds that the following model represents the rural economic development process.

$$RE_{it} = f(M_{it-1}, U_{it-1}, C_{it-1}, L_{it-1}, A_{it-1}, B_{it-1})$$

Where

RE_{it} = Total or new Jobs in rural county *i* during decade *t*
M_{it-1} = Market Size of county *i* in the decade before *t*
U_{it-1} = Urbanization and Localization Economies of county *i* in the decade before *t*
C_{it-1} = Local Cost Factors of county *i* in the decade before *t*
L_{it-1} = Labor force Qualification of county *i* in the decade before *t*
A_{it-1} = Accessibility of county *i* in the decade before *t*
B_{it-1} = External Business Cycle in the decade before *t*

To ensure adequate causality, the model utilizes a ten-year lag whereby the economic development, measured in jobs, at the end of one decade is a function of the growth or decline in the other factors in the preceding decade. Economic development is defined according to job growth because within the policy context, job growth is the most common goal of increasing highway investments for development (Harrington 1989). Income was not included because those statistics include government transfer payments and not purely employment income.

The model assumes that profitable and productive firms have increased output, which in turn, allows them to increase their labor force. Employment change is the primary measure of employment growth, and thus economic development, for this research. Several different employment measures are included to account for shifts in sector employment in the areas. Total and new employment is used to measure the overall effects of economic development. Manufacturing employment is used to capture the specialization that may be increasing or declining within an economy. Finally, Private, Non-Farm employment is used to measure the effects within the commercial labor economy.

Data were collected at the county level in ten-year increments for decades between 1970 and 2000 (with population data collected for 1960) for each of the factors except GDP, which is a national statistic. For this paper, the unit of analysis is the county. Designation as rural is determined by inclusion in a Metropolitan Statistical Area (MSA) during the 1970 Census. Those counties not in MSAs in 1970 are rural, and the other counties are considered urban. The result is that, over time, some counties that were rural in 1970 are currently urban due to inclusion in previously designated MSA or from becoming new MSAs. The US Office of Management and Budget designates MSAs for Federal statistical purposes.

The general concept of a metropolitan area is that of a geographic area consisting of a large population nucleus together with adjacent communities having a high degree of economic and social integration with the nucleus. MSA designation was chosen in order to standardize measurement over time and across geographies. Since economic activity does not explicitly recognize county borders, MSA designation provided the best way to ensure the capture of most regional economic effects. Though growth occurs in some instances without respect to political jurisdiction, policy decisions are made within the framework of municipalities. Therefore, the factors influencing development are functions of county borders. Finally, the MSA standard is applied throughout the United States, thus it allows for application of this model and research in other states.

COUNTY SELECTION AND CLASSIFICATION

The treated counties to be studied were selected from among 1,360 counties which contained interstate highway mileage as of 1987 or were located close to an interstate. Interstates are built to higher engineering standards and accommodate higher traffic volumes than noninterstate routes. Holding all other factors constant, interstates should have larger economic effects than qualitatively poorer highway classes because of their greater capacities and traffic volumes. The treated counties had to meet additional criteria to be studied further. Construction characteristics and data availability were the most important factors. The interstate highway program began in 1956, and most of the mileage was open to traffic during the 1960s (see figure 2). However, annual income data for counties from the Bureau of Economic Analysis (BEA) are spotty during the early years of the program and do not become continuous until 1965. Also, the series that includes 1965 ends in 1984 because the BEA subsequently changed its accounting conventions and

chose not to revise its personal income and earnings figures any further back than 1969. Balancing the multiple goals of maximizing the number of study counties, avoiding data gaps, and obtaining a sufficient number of years for impact analysis led to selecting 1962 as the base impact year. This choice means that the period 1950-59 is used for matching counties, the 1959-62 period is used for the pre-test, and 1962-84 is the treatment period. In order to have enough treatment period years to make inferences about post-construction effects, all treated counties had to have both the beginning and end of construction during the period 1963-75.

Three additional restrictions were imposed in selecting treated counties. First, they had to contain at least nine miles of interstate, thus screening out counties that were less likely to have interchange access and avoiding situations in which an interstate highway merely nipped the corner of a county. Second, all the counties had to have the same suppressed variables in the BEA data for the Mahalanobis metric to be computed. Thus, counties with suppressed data for variables other than three frequently suppressed sectors, agricultural services, forestry, and fishing, mining, and finance, insurance, and real estate, were ineligible as either treated or untreated counties. Finally, all off-interstate counties had to be within 30 miles from the population centroid of a selected county with interstate mileage. These screening rules resulted in a group of 142 interstate treated counties and 192 off-interstate counties.

County classification

Five groups of counties help examine the economic effects of highways. The first serves to investigate the linkages between construction activity and county economic growth, and the remaining four serve to examine the post-construction effects. Beginning with the latter, competitive counties contain substantial urban areas and are expected to experience positive stimulus to tertiary and manufacturing industries. Urban spillover counties are close enough to urban areas to experience substantial spread effects, usually through residential decentralization from a nearby city. Uncompetitive counties are predominantly rural and relatively far from cities, so highway improvements might not create locational advantages for residential settlement or industrial location there. Adjacent counties are relatively close to the treated counties but located off the interstate. They might experience few positive economic impacts and possibly lose locational advantages for locally provided goods and services to counties located along the interstate highway.

The effects of highway construction must be studied using a group of counties with highway construction schedules that are brief and overlapping. The short construction interval maximizes the likelihood of capturing heavy construction activity instead of a drawn out period of surveying, land acquisition, and other work. The coinciding schedules avoid mixing post-construction effects in some counties with construction in others. Counties were selected for this group if their highways required four years to complete, start to finish. In order to maximize the number of study counties, time is measured with respect to the initial year of construction instead of chronological year. Therefore, counties with construction occurring during the time period 1965-68 are joined by counties where construction occurred 1966-69, 1967-70, and so on through 1971-74. Twenty-four counties representing a diverse cross-section of the 142 interstate highway treated counties met this criterion.

Counties were assigned to the four spatial categories based on central place characteristics, as approximated by the counties' distances to cities of various sizes and proximity to counties containing interstates. Because of data availability, only cities with more than 25,000 residents in 1960 could be identified. Competitive counties contain cities with 25,000 or more residents. Because most larger cities already had some freeway construction which was converted to interstate status in 1956 and were therefore not feasible for study, the cities in these counties are generally small (the largest, Fresno, CA had only 133,929 residents in 1960). Thus, this category consists primarily of small cities. Urban spillover counties are near large cities.

The urban fields of large cities will diffuse much greater distances than smaller cities, so the potential for any given county to experience urban spillover depends on the size of the nearby city and distance to the city (Fox and Kumar 1965; Berry and Gillard 1977). Three assumptions are made in identifying spillover counties:6 (1) counties within sixty miles of counties with large cities (i.e., cities with at least 250,000 residents) are urban spillover because sixty miles approximates the urban field for larger cities (Berry and Gillard 1977), (2) counties within forty miles of counties with mid-sized cities (i.e., cities with at least 100,000 residents but less than 250,000) are urban spillover counties, and (3) counties with small cities (i.e., cities with at least 25,000 residents but less than 100,000) are too small to generate spillover effects. All remaining interstate counties are in the uncompetitive group. Although they may be adjacent to counties with small cities, they are beyond the reach of urban spillover and have no cities with 25,000 or more residents. Finally, adjacent off-interstate counties are located within 30 miles of the 142 interstate counties studied here. Altogether, there are 13 competitive, 48 urban spillover, 81 uncompetitive, and 192 adjacent counties. More observations would have been preferable for some of these categories but were not possible because of data suppression and the limited number of counties getting interstate highways in any given period.

ANALYSIS OF RESULTS

The pre-test provides a means for assessing the suitability of the matched twins. Its null hypothesis is that there is no difference between the growth rates of the treated counties and their untreated twins before the highways were constructed. The pre-test results for each of the five categories. In each instance, the number of significant differences in 1959-62 mean growth rates is four or less. Among the highway sensitive sectors, significant differences are relatively rare. Exceptions are population for the competitive counties, state and local government for the uncompetitive counties, and transfers and retail trade for the adjacent counties. These variables are important for post-test hypothesis testing, and, if they are not random occurrences, the differences are troublesome for inferring impacts. On the other hand, the fact that a Hotelling T2 test calculated using a vector of nine highway sensitive sectors where data suppression is unproblematic (total, earnings, population, residential adjustment, transfer payments, construction, manufacturing, retail trade, services, and state and local government) revealed no statistically significant differences suggests that the matches are good. Therefore, the pre-tests are passed, and the twins are deemed adequate for use in the treatment period.

Construction stage effects on rural economies

Figure 1: shows pre and post-test results for industries that are expected to have strong construction linkages (based on the input-output simulations reported in section 2.2) using the twenty-four county highway construction group. During the construction period, each of the sectors exhibits positive effects.7 Residential adjustment has a negative mean growth residual, suggesting that incommuting, possibly of construction workers, leads to an earnings leakage during the period. However, only the effects on construction and total earnings are statistically significant, and then, only for one and two years respectively. The performances of the other sectors do not appear to be linked strongly to the construction stimulus, even when statistical significance is ignored. Retail trade and manufacturing growth achieve their maxima in years three and four rather than the second year when construction peaks. These results suggest that highway construction can affect overall county growth, but it does not induce a local boom period characterized by broader sectoral effects. Leakages may be so substantial or the direct effects so small that other construction sensitive sectors are not affected.

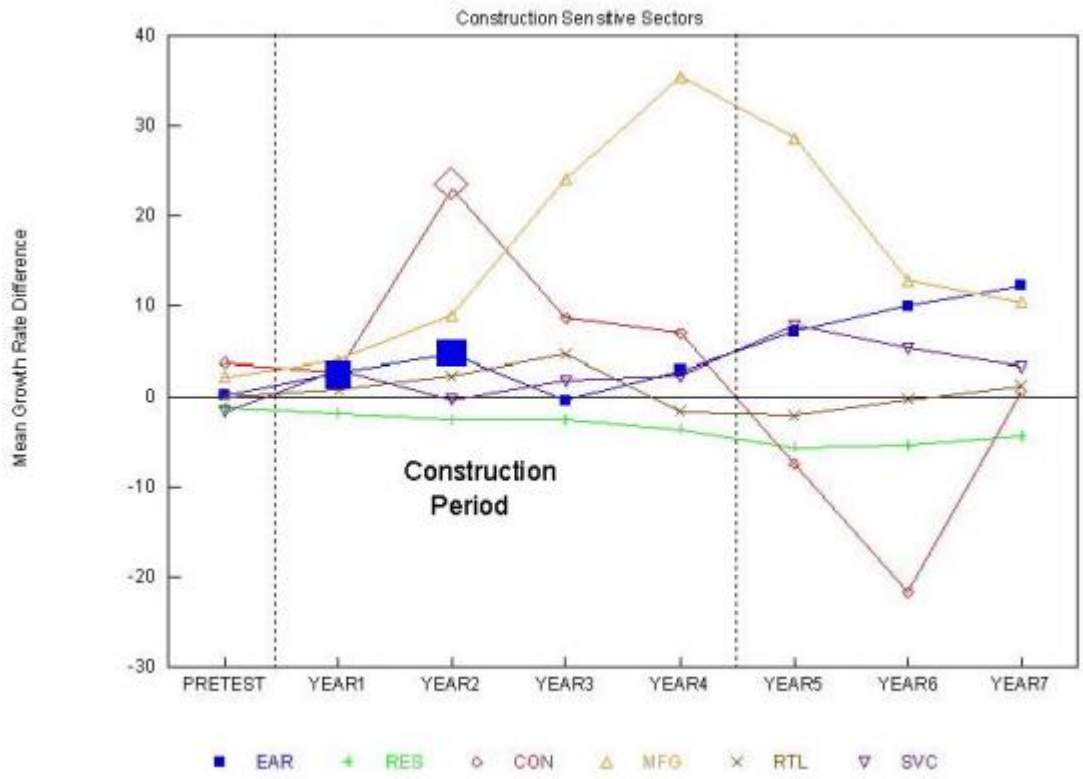

Fig. 1: Highway Construction Effects

Urban spillover

Urban spillover counties show the most profound, sustained, and propitious aggregate income effects. Total income (unpictured) exhibits positive and significant effects throughout most of the period following the completion of all treated county highway segments. It is accompanied by positive, significant population differences throughout much of

the period and statistically significant total earnings differences during the final three years. However, the total earnings effect is not as large as the total income effect, indicating that part of the income effect is the consequence of residential decentralization and income sources tied to new inmigrants (transfer payments and dividends, interest, and rent). Residence adjustment turns positive in 1974 and achieves a statistically significant result for five of the last six last years. This effect is accompanied by positive and statistically significant transfer payment income differences. This latter result suggests that interstate highways may attract older inmigrants to outlying areas of urban areas, which become more appealing as residences when served by interstate highways.

CONCLUSION

This study has employed a quasi-experimental matching method to examine the regional economic effects of interstate highways. It has focused on such highways because they have often been advocated for the purpose of stimulating economic growth and development. Federal and state highway programs, including current legislation, have been justified, in part, by the claim that additional freeway mileage will enhance the economic competitiveness of predominantly rural regions. The new empirical work presented in this study, as well as careful assessment of the theoretical and empirical literatures, calls into question some of these claims. The main beneficiaries of the interstate system in terms of economic growth have not been isolated rural regions or regions in close proximity to the system. Instead, the areas that have benefited most are those in close proximity to large cities or with some degree of prior urbanization, such as counties having cities with more than 25,000 residents. These results have implications for public policy that are worth pondering. New freeways can be a useful part of a growth center strategy to reinforce the competitive characteristics of small cities. Counties with cities of 25,000 (or even less perhaps) can be stimulated. Yet, the largest economic changes will be on the urban fringe of larger cities. This conclusion dovetails with conventional wisdom and contradicts the predictions of early interstate highway planners, who argued that new highways would aid urban revitalization and curtail decentralization (Rose 1990).

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