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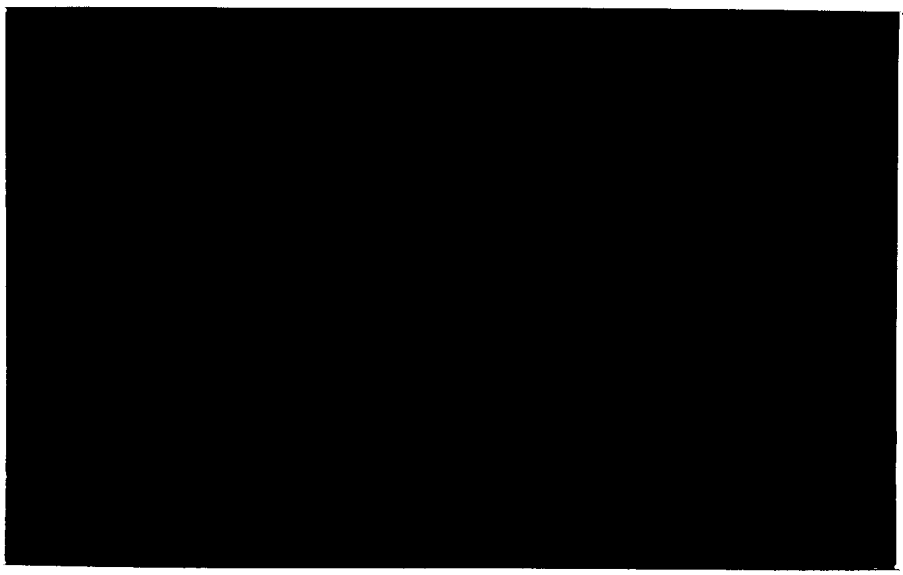

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ISSUES IN ENERGY FACILITY IMPACT FORECASTING

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I. INTRODUCTION

This manual provides information to increase understanding of energy facility economic impacts. It is based on studies of rural industrialization throughout the U. S. and energy-impacted communities in the Rocky Mountain and Northern Great Plains states. Some concepts and assumptions implicit in the forecasting procedures and specific findings of empirical data are also explained. This is necessary because many of the issues are not well known or understood. Questioning of procedures or use of data may be expected from local government officials, due mostly to not understanding or misunderstanding the factors involved. In addition, there are potentially important factors which are not used in forecasting procedures due to limitations of available data or methodological difficulties. These factors may change certain expected forecasts and are noted in their discussion. In communication with the applying local governments, these factors can be discussed to provide information for adjustment of the forecasts for that community.

The narrative is divided into three sections, treating issues of (1) the community/resident split and population impact on small local areas, (2) employment multipliers, and (3) fiscal impacts. The first two sections are directly related to the most important issues in the forecasting model. The third section is also relevant, but includes description of less related fiscal impact experience to illustrate misconceptions that may exist among local officials regarding fiscal benefits from industrialization.

Other parts of the manual include an annotated bibliography, and copies of important studies of economic impact issues.

II. THE RESIDENT-COMMUTER SPLIT

The commuting radius of employees to an energy facility is likely to exceed the boundaries of small local governments. Thus, an allocation of increased employment must be made among local areas. While this problem is critical for forecasting impact on local governments and is not a problem for large area forecasting models, this issue has not received significant attention as a forecasting problem. Thus, the technique utilized, while the best available, must be viewed with caution until more evidence on this problem is obtained.

The allocation of employment to geographic areas around a facility is based on the gravity concept. This concept holds that the interaction between two points or places is a function of population and distance. It is directly proportional to its population and inversely proportional to the distance between the two places. For our purposes the interaction is commuting to work. The object of the formula is to forecast the distribution of direct employment to the local governments surrounding the facility site. The gravity concept applied to commuting means that the facility attracts employees from surrounding areas in direct proportion to the population of a particular local government. The larger the population, the greater the number of employees who will live there. And, the facility attracts commuters from surrounding areas inversely related to the distance between the facility and the area. The farther the local government from the facility site, the fewer the number of employees who will live there.

The distribution forecasting formula used in the CEIP Impact Model is the result of several case studies' findings and the analyses of twelve different specifications (5, p. 125). These studies looked at commuting in nonmetropolitan areas. Conditions were similar to the expected conditions of energy impacted in coastal areas. Distance could be used as a substitute for travel time. The evidence from these studies suggests that in rural areas there is a propensity to remain in established residences and a willingness to commute long distances to work. Rural and small town residents commute long distances with the opportunity to work in an industrial plant.

Commuting patterns in one small nonmetropolitan area were studied with data collected from a total of 1,645 employees from two firms. The two patterns were compared and their characteristics analyzed. There was a major difference between the two employee groups' commuting patterns. The average one-way commuting distance of the fiber plant employment was 17.5 miles. This compares with the shirt factory's much smaller average one-way distance of 6.7 miles. The median distances were 13 miles for the fiber plant and 4 miles for the shirt factory employees. Approximately 54 percent of fiber plant workers lived within 15 miles of the plant. Of the shirt factory workers, 80 percent lived within 15 miles of the factory. The state average for workers living within 15 miles of their work place is 77 percent. Thus, the fiber plant work force is drawn from distances farther than are most workers in the state; the shirt factory draws most of its work force in a smaller radius than both the fiber plant and the state average. Slightly more than 15 percent of the fiber workers travel 35 miles or more to work, while less than 1 percent of the shirt factory employees commute that far. In fact, 7 percent of the fiber plant workers commuted over 60 miles to the factory. The comparison of the two plants' commuting patterns shows that there is a significant difference in the distances traveled to work for the two groups. The labor-shed, arbitrarily defined in this case to include the closest 90 percent of the two factories' labor force, is nearly twice as extensive for the fiber plant as for the shirt factory: 38 miles and 20 miles.

Wage differences are the primary factor explaining the significant difference between the two commuting patterns. The wages paid by the fiber plant were substantially above those in the surrounding area and the state. The shirt factory wages were below both area and state wages. Previous studies have left researchers in dispute over the relationship of wages to distances commuted. However, the comparison of the lower and the higher wage groups within the same community suggested that wages have a significant impact on commuting. But it was evident that only when wages were compared with those in the immediate area did they affect the willingness to commute long distances. Several other studies were conducted in similar economically depressed, small nonmetropolitan areas. A comparison of the existing area opportunities and median one-way distances commuted in these studies with those of the fiber and shirt factory shows that wages do have a significant influence on the willingness to commute longer distances, particularly in the "lower wage" environments. In this respect energy facilities will have "high wages" and, thus, draw on a very large labor market area. Thus, commuting distances forecast in the model for an energy facility may be longer than existing employment commuting, but this result is warranted by previous studies.

A second important study finding is the tendency, over time, to move closer to the place of employment. Nearly ¼ of the fiber plant workers and 1/6 of the shirt factory workers had moved closer to their place of employment since they began work there.

And other employees who had not relocated indicated future intentions to do so. The median distance commuted since the opening of the fiber plant dropped from 28.8 miles to 13 miles. The shirt factory shift was less, mostly because it was located inside the town (the fiber plant was 7 miles outside the town).

The existing road networks were also found to influence the commuting pattern. Each of the 1,645 employees of the fiber and shirt factories plotted their residences on a map provided. The effect of road networks is evident from the residential locations. They extend farthest out along main or radial roads.

In addition to case study findings, the results of 12 different exponents of distance were tested to obtain the best prediction. Both time and mileage were used as measures of distance, but one was found to be as good a measure of distance as the other. Mileage, however, serves forecasting purposes better because it is more easily determined. While the models fit very well, each understated or overstated the actual numbers contained in the various zones by some amount. In an attempt to account for the deviations between the model and actual distribution, several other factors were tested.

Per capita income, population density, and intensity of agricultural employment of the local area were found to have an effect on the commuting patterns of the fiber workers. These three variables explained a major portion of the deviation from the expected distribution. Those districts generating more commuters than expected were low (population) density areas, had lower per capita incomes, and a high percentage of the labor force was employed in the agricultural sector. These three factors, which are not accounted for in the forecasting formula, may indicate an adjustment from the forecasted distribution.

To summarize, the forecasting model should give good results if the energy facility has higher than area-average wages and travel time and distance are approximately equal in different commuting directions. The over forecasts, however, should be discussed with local officials to discover any conditions unique to a particular community.

III. EMPLOYMENT MULTIPLIER

Industrial development in rural areas if often expected to result in many new jobs and to stimulate the local economy. However, the evidence indicates that the secondary employment affects from development are relatively small. The range of reported multipliers for small areas is 1.00 to 1.71, the majority of which are less than 1.2. These figures are lower than those generated by regional impact models. These multipliers range above 2.0. State or regional models and models based on cross-sectional data consistently predict much more secondary employment than is evidenced from case studies of small areas impacted by industrial development.

The following sections discuss the principles that significantly effect the mutliplier. Several factors with a less significant effect are also discussed to give a more complete description of the multiplier effect.

GEOGRAPHIC SIZE OF THE AREA

Since secondary jobs tend to locate around already existing business activity, smaller areas with fewer existing jobs will have fewer additional jobs and a smaller multiplier effect. Very small areas have small multipliers. However, smallness is not important after a county-sized area is included. The effect of geographic size, beyond that of a single county, on the size of multipliers was the subject of two case studies. Expecting to find size an important factor, one study extended its consideration of one-county area to a four-county area, and the other study extended its boundaries to an eight-county area. They assumed that extension of the geographic boundaries would increase the degree to which secondary employment effects would be internalized. But the impact was not significantly larger due to the size change at the county-area scale.

SIZE OF THE FACILITY WORK FORCE

The size of the facility work force is a factor associated with the indirect and induced employment growth. The size, however, is not directly related to the size of the multiplier. For example, Box Elder County, Utah, with its rocket fuel and missile fuel development, had a total direct employment of 5,688. This is large when compared with other industrial plants. This figure is also high for most energy facilities in the beginning of operation. The multiplier was low -- 1.34. In contrast, Braxton County, West Virginia had 77 employed in the particle board plant, and a multiplier of 1.50.

The following sections discuss industry and local economic conditions, which have a more significant impact on the size of the multiplier than do the size of the industry work force and the geographic size of the area. Diversity of local economic activity, forward and backward linkages of the industry, payroll leakage, underemployment, excess business capacity, and the number of unfilled vacant jobs, all have significant impact on the size of the multiplier.

DIVERSITY IN THE LOCAL ECONOMIC ACTIVITY

Diversity in local business activity has a significant impact on the number of new jobs generated by the facility. There are several ways in which diversity is important. First, there is an affect of the size of the existing commercial and business sectors on the amount of trade carried on within the local market. Communities with only a few or no commercial and industrial establishments are more dependent on imports, and do not seem to gain many indirect or induced jobs through increased business activity generated by new industry. This is a major reason why small areas have smaller multipliers. They do not have the existing commercial and business capacity to promote higher growth of secondary employment.

The second aspect of diversity important to the number of indirect jobs generated by new industry is the size of the community's existing manufacturing sector. There is empirical evidence that industrialized areas with manufacturing activity have higher multipliers.

CURRENT GROWTH

When areas contain both a large manufacturing sector and a high growth rate, multipliers tend to be high. Studies of impacts in county areas with these characteristics indicate multipliers of 1.65 and 1.68 -- close to the top range of multipliers identified in several hundred studies.

FORWARD AND BACKWARD LINKAGES TO INDUSTRY

Nonmetropolitan communities are also limited to small multipliers by linkage to external markets. Backward linkages are the suppliers of inputs to production. Forward linkages are the connections with external markets for the manufactured product. Industries which depend upon local business to supply the raw materials and services for production, and whose product is consumed on the local market, produce more of an employment impact in those businesses than if the industry were linked to external markets. From the increased economic activity employment is induced in those sectors which do not directly service the industry, in addition to those which do. An example of a small area with a high multiplier is Braxton County, West Virginia. Braxton was able to supply nearly all timber and coal to the particle board plant located there. As a result of the internally supplied raw materials, Braxton had a high multiplier of 1.50. Box Elder County, Utah, in the other extreme, was little more than a labor supply for the rocket fuel and missile fuel industries. Nearly all the raw materials were "imported" into Box Elder, and the product was distributed to external markets. The secondary employment growth was moderately small -- 1.34. The researchers who studied Box Elder attributed the small multiplier effect to the lack of interaction between industry and local businesses. Energy facilities are characteristic of the latter kind of linkage. As with the rocket and missile fuel industry in Box Elder, secondary employment growth in the local business and service sectors is expected to be small because raw materials are imported and products exported.

PAYROLL LEAKAGE

Payroll leakage refers to the facility wages and salaries paid to nonresidents. These employees commute to work and tend to spend their income in their place of residence. For some areas this does not present a serious problem, since the direct employed are community residents and the number of commuters are small. In these cases there is little of the facility income "leaked" out of the local area. But there are communities where a substantial number of the facility employees are not local community residents. Studies of these cases have found substantial leakage evidenced by low multipliers. One study reported 30.8% of the nonresident employees spent about 40% of the factory income outside of the community. In this instance, the purchasing power added through industrial employment leaked out and did not contribute to the creation of new jobs. The lack of respending had a restricting affect on the number of jobs generated by the new factory. In the case of an energy facility, the multiplier is expected to be lower during the construction phase, due to the higher number of commuting construction workers. Commuting is also expected to be significant in the case of the energy facility operation phase due to the lack of available labor in the community with the skills required for the job. This labor must be "imported" to the facility location. The problem presented by the lack of local labor with the necessary skills is an important component of the total number of unemployed who will be hired for indirect employment, and will be discussed further in the section explaining the unemployment issue.

UNDEREMPLOYMENT

The amount of existing underemployment is an important factor of growth in indirect employment. To the extent that local businesses can handle increased business without hiring additional employees or increasing the capital stock, there will be no significant increase in secondary employment. This is easy enough to understand. The problem lies in the measurement of underemployment. Underemployed include those working less than full-time hours and those employed in jobs for which they are over qualified based on previous experience, skill, and education. There is no systematic method for detecting the amount of underemployment. What little is known about the extent of underemployment was collected through surveys conducted in studies of particular local areas. No methods of identifying or measuring the underemployment have resulted from the studies. The best estimates of the extent of underemployment in a community are obtained from local businessmen or business associations. Some communities will have a better idea of the existing conditions than others. But an estimate for this factor is important, since this has a significant effect on the number of jobs which will be generated by the new facility.

EXCESS BUSINESS CAPACITY

In addition to the problem of detecting and quantifying the existing underemployment, there is an additional effect on secondary employment growth of excess business capacity. Excess capacity will absorb economic business activity and decrease the number of jobs generated by direct employment. This effect was noted in one case study of new industry in five small communities. The multipliers ranged from 1.00 to 1.18, and the excess capacity in capital stock of the supporting goods and services was cited. There was particular excess capacity in the construction industry, where there was little induced and indirect employment growth. Historical data for the community are helpful in determining the communities likely to have excess capacity in business and commercial sectors. These are communities which have experienced economic and population declines in the past 10 years or so. The variability of this factor is why direct impact estimates by local businessmen are used in the CEIP Forecasting Model.

UNFILLED VACATED JOBS

Another factor which contributes to the low multipliers found in small communities is that jobs vacated by employees taking jobs with the new facility often are left unfilled. Empirical data show a substantial amount of unfilled vacancies, particularly when the vacant jobs are paid a lower wage or salary than jobs with the new direct and induced activities. In a study of employment patterns, employers were interviewed and asked the previous employment status of their employees. The study reported most employers answered that there was considerable hiring of workers from other industries. Figures as high as 19.3 percent of the vacated jobs are reported unfilled. This is one factor that few models take into account in their calculations of the multiplier effect of new industry. It is important to recognize that not replacing employees who go to work for the energy facility can have a substantial role in reducing the size of the multiplier. This factor is probably not recognized by local officials as a contributor to a lower secondary employment effect. But this information, like the underemployment and excess capacity data, is not systematically collected. It is another reason, however, for the use of small multipliers in the CEIP Model.

INCREASED PARTICIPATION IN THE LABOR FORCE

Increased participation in the labor force is even more difficult to adjust for than is unemployment. Very few studies have measured the potential labor force in an area, nor have specific variables associated with increased participation been identified. The result is that there is no specific data available to determine for a given area who will enter the labor force and under what conditions. However, the studies do suggest explanations for the increased participation in those areas experiencing increases. The most evident explanation is the opening of job opportunities on the local market. Empirical results point to increased participation as new opportunities are made available. Participation rates seem to be more a function of the demand for workers and wages than of the number of existing and potential labor force. While this observation is helpful in developing a theoretical understanding of labor force participation, it does not provide a method for determining the number of those expected to enter the labor force. The national employment/population ratio has been a basis to compare the amount of labor force participation on the local level. The rational here is that the national ratio is an average or expected participation rate, and divergence from this rate indicates the amount of additional participation which can be expected with an increase of employment opportunities. The studies of labor force participation report marked increase in participation in the communities, with pre-industry rates much lower than the national ratio. The lower the labor force ratio compared with the national average, the greater the probability potential members will become active. One study of industry employees found the proportion of new industry employees not previously in the labor force was substantial -- 25%-34%. The increase of local participation in the labor force is most likely in areas of economic and population decline. This is an indication that there is potential, although local business and civic leaders who know their community are the best sources for the estimates. As with the other factors of economic and employment growth, which is not well documented, the national-local labor force participation adjustment is not perfect but it is feasible to use with the information available.

UNEMPLOYMENT

Predicting the distribution of the secondary jobs between local and new residents includes an assumption that 30% of the unemployed are hired in direct or secondary jobs. Previously, it was assumed that new industry locating in a declining area would hire many of the unemployed; substantially raising economic conditions in the local area. But the results of studies of rural industrialization have not supported this belief. New industry does not significantly reduce the number of unemployed. And in some instances, unemployment increases. One of the main reasons for this is the hiring practices of employers. Other applicants are preferred to the unemployed, who are viewed as a risk. Immigrants, commuters, returnees to the area, and those already employed who quit to take a job with the new industry, are hired before the unemployed are. The higher educational levels and skills attained of the incoming and already employed people are the reasons cited for the preference. In most cases studied, the unemployment rate decreased, but only by about 2 percentage points. The number of direct jobs filled by previously unemployed persons was small. The range was 1.0 percent to 43 percent, and only in three instances was the proportion above 14 percent. The only studies which concluded the unemployment rates fell substantially (more than 2 percent) were those of EDA programs, which provided manpower training, direct financial support, and employment-related requirements by industry for program funding. A second reason for such a small decrease in the unemployment rate when new industry locates in a community is the mismatch of skills between industry demand and readily available labor in the area. Case studies have reported that the higher wage, higher skill industries draw more of their employees from immigrants and commuters and less from the unemployed, than do the lower wage, lower skill industries. Since both the construction and operation of the energy facility require particular skills, the conditions for mismatch are expected in hosting communities. Based on the evidence supporting these expectations, .3 of the unemployed <u>indirect</u> labor force, are expected to join the direct and indirect labor force. If local officials believe the unemployed in their community are comprised of higher skilled and educated people required for direct and induced employment, additional adjustment may be advisable.

RELATION TO CROSS-SECTIONAL DATA BASED MODELS

The CEIP Model uses the small multipliers actually identified in case studies of economic impacts on small communities. Two major sources of the difference with higher multipliers estimated from cross-sectional data are 1) the lack of employers refilling jobs vacated by employees who are hired by the energy facility; and 2) the smallness of the areas impacted. We believe that to use multipliers based on cross-sectional data or multipliers based on large areas will grossly overestimate impacts of energy facilities on local communities. This is likely to be a major point of difference between the CEIP and alternative models. From all evidence from <u>actual impact studies</u>, the CEIP Model assumptions are supported <u>by the evidence which</u> exists at the current time.

IV. FISCAL IMPACTS

Nearly all growth in public revenues depends on growth in the private sector. Studies of fiscal impacts on local governments show that whatever the gains made in the public sector, they were small in comparison with those achieved in the private sector. Furthermore, if the benefits of industrialization were better channeled, they could have made a more significant impact on local government fiscal well-being. Most studies of rural industrialization find the costs to local governments higher than necessary. This is because financial inducements to industrial locations are not fully recovered. These inducements may be one-time costs or they may be in the form of services provided to industry at less than cost.

Locational costs include advertising expenses, tax holidays, low interest financing, land acquisition, and site preparation. If the local government purchases the land, there is the loss of previous revenue since government property is not taxed. Tax holidays, which relieve industry of paying any or all taxes lasting as long as 20 years, have been cited by industrialization studies. And it is common practice to tax industry at a lower rate, inducing industry to locate in the area. Site preparation includes extension and improvements of access roads, utility connections, landscape modification, and construction of buildings.

Service provision has been another high cost to local governments. In providing public services like police and fire protection, water and sewerage, electrical and/or gas, and access road maintenance, payments do not always equal the costs of providing them. In some cases, the local government has funded and built utility or sewerage treatment facilities for the industry. Environmental damage has also required public expenditures. Case studies have found that runoff from development has caused serious problems with water systems. Capital expenditures for new or expanded storm sewerage systems were necessary. All of these subsidies are actually costs to the community. In the past it was believed that these costs would be recovered indirectly through the increased business and personal incomes generated by the additional economic activity but empirical evidence disputes this. In some instances the costs are recovered over time, but more often they are not.

Industry's indirect effect on the public sector is through population growth and change. The first effect is the increase in personal income in the local area. Increases in personal income make their way into the public financial sector through two avenues. Property tax revenue is increased. The extra earnings are put into upgrading the standard of living either through home (property) improvement or through a new home purchase. Secondly, there is an increase in retail sales tax revenue or business taxes for local governments using these tax sources. Increased income generates more retail sales or business, which is accompanied by an increase in tax revenue from those sales. But empirical evidence shows that increases in public revenues resulting from increased income is often not as significant as the income growth itself.

While public revenues increase less than private incomes, studies consistently report increases in local tax revenue. The major increases are in retail sales tax revenues, intergovernmental transfer payments, and property tax revenues. For example, the property tax has been observed in many studies as being especially unresponsive to economic growth in the private sector. This presents a serious problem in many local governments. They lack the operating and the "front-end" capital for expansion of facilities which are warranted by residential growth. There are two reasons evident for the lack of growth of local property tax revenues, particularly residential property tax revenues. One is the conditions determining construction and development of residential property. The other is the "lag" associated with property tax assessment and collection. Residential property tax growth is dependent upon several factors in the housing market. The distance to other housing markets influences residential construction and development. Neighboring communities "compete" to provide housing for employees new to the area. Potential residents are lost to nearby housing markets. A second factor is the availability of existing housing. Those who can find vacant housing will have no need to construct homes. Thus, the amount of vacant housing and nearby housing markets consequently minimize growth of property tax revenues.

Another factor which affects residential property revenues is the amount of commuting to work. The more people who commute into the area, specifically for direct (facility) employment, the fewer the number of new residents. Although there is a tendency to move closer to the place of employment over time, the increases in property tax revenues from residential development are potential, at best. As studies of energy-impacted communities in the western states have noted, assessed valuation in residential properties rose very little in response to the economic development. There was little increase of those revenues in inflated dollars and none at all in terms of real dollars.

There are two "lags" associated with property tax assessment and collection. Local governments may be affected by one of these or both. The effect is called a lag because of the time that elapses between the value increase of the property and tax receipts accruing to the government. The first lag occurs with property assessments. Property is assessed periodically at a specified time period. If residential building construction or other property development is completed after the assessment date, property will not be assessed until the next year. The second lag occurs between the assessment and collection of the tax. Often the tax "bill" is not collected during the same fiscal year the assessment is made. Over the years some states have changed fiscal years, while assessment and collection dates remain the same. These lags do not actually diminish revenues. Rather they limit the available revenues during the first years of construction and operation of a new facility, precisely when new government expenditures may be needed to service the facility and its expected population. In Table 1, a summary of revenue sources and their implications for revenue growth in response to energy development is presented. While The Tax Lead Time Study (6, Sec. 3) was prepared for the state of Colorado and is specific to certain rates and taxable goods and services, it still offers basic information on the responsiveness to private sector growth of various taxes.

In many case studies it has been discovered that additional revenues are often not sufficient to cover increased demands for basic services. First, with the increased incomes generated by industrial development, historical empirical data show an increase in the quantity and quality of demand for public services. Second, an increase is evident due to population growth, often requiring capital outlay. This has been especially true of utilities such as water and sewerage treatment and schools. Existing capacities are overloaded by new population, so new or extended facilities are necessary. Usually the increase in user charge revenues for utilities and property taxes and state aid for schools does not cover the capital costs. This puts a burden on the finances of the government, particularly on capital expansion which is necessary to provide services to temporary residents. As is the case with most energy development, there is an employment and population decline after construction. This often leaves the permanent residents bearing the financial burden of the extended, and now underutilized, service capacity.

Predicting the response of a local government to population growth is extremely difficult. In the CEIP Model the historical increase in expenditures added by each new person is estimated, and this estimate is then used to forecast the increase in expenditures associated with new population. This technique is better than simply multiplying average per capita expenditures by the expected population increase -- but it is still a very rough estimating procedure for large population changes.

Increases in revenues are forecast in a similar manner. The historical increase in revenues associated with new population is estimated and used for forecasting, while taking into account property tax revenue lags. In addition, each taxable element of the energy facility itself is forecast and revenues calculated. In general, as much importance should be given to the forecast differences between revenues and expenditures in the CEIP Model as to their absolute levels. It must also be remembered that the revenue and expenditure forecasts depend upon previously estimated population changes, which in turn depend on multiplier and residential-commuter employee split estimates. At each step

TABLE I

Revenue Alternatives For Colorado Local Governments

	GENERAL SALES TAX	SELECTIVE SALES TAX	USE TAX	AD VALOREM PROPERTY TAX
DESCRIPTION	Excise tax levied on retail sales of tangible personal property (sometimes services) made inside the taxing jurisdiction.	Excise tax levied on retail sales of certain products inside taxing jurisdiction. Most common are tobacco, alcoholic beverages, motor fuel, public utilities, insurance, and parimutuels.	Tax on the privilege of storing, distributing, using, or consuming articles of tangible personal property in the taxing jurisdiction and on which no sales tax has been paid. It is generally complementary to sales tax.	Ad valorem tax computed on the assessed valuation of all property, real and personal, located within the territorial limits of the authority levying the tax.
YIELD	For 1% tax, state average is $35 per capita annually. Localities vary as much as ±$20 around state. No important collection lag with respect to economic development.	State Averages: Cigarette tax--10 cents per pack yields $13 per capita annually. Alcoholic beverages--30 cents per gallon yields $6-$6.50 per capita annually. Motor fuel--7 cents per gallon yields $45-$50 per capita annually. No significant collection lag with respect to economic growth.	Generally about 1/10 the yield of a comparable general sales tax. For 1% tax, the state average is $3 per capita annually. No significant collection lag with respect to economic growth. For local governments, most revenue comes from use of building materials and motor vehicles.	For non-industrialized, but urbanized areas, a levy of 75 mills raises from $150-$225 per capita annually, the higher range for more urbanized areas. Each oil shale retort plant will generate roughly $10 million annually on a mill levy of 75 mills with up to a 2-1/2 year time lag in collection.
LEGALITY	Legal for home rule cities, counties, statutory cities and towns. Election required in all but home rule cities (unless charter requires election). 4% maximum cumulative levy for all cities and counties in any one location.	Legal for home rule cities. No statutory authority for counties, statutory cities/towns. Localities with cigarette taxes do not receive cigarette tax distribution from the state.	Legal for home rule cities and statutory cities/towns. No authority for counties. 4% maximum cumulative levy for all cities and towns in any one location.	Legal for home rule cities, counties, and statutory cities/towns subject to extensive charter, constitutional and statutory limitations.
ELASTICITY	Unit elastic (range 0.8-1.3)	Strongly inelastic (range 0.0-0.8)	Unit elastic (range 0.8-1.3)	Moderately inelastic (range 0.4-1.4). Property tax base in Garfield and Rio Blanco counties will be dominated by oil shale facilities, not by local economic conditions.
INCIDENCE	Regressive to income. Neutral to household size. Taxes non-resident visitors. Relief programs can reduce regressivity.	More regressive to income than general sales tax. Neutral to household size. Taxes non-residents and visitors.	Same as general sales tax. Particularly hits purchasers of motor vehicles and construction and building materials.	Regressivity similar to general sales tax. Neutral to household size. Relief programs can reduce regressivity. Oil shale facilities will dominate tax bases in Garfield and Rio Blanco. Much of the tax would be exported out of the region.
CONTROL	High degree of local control for home rule cities. Statutory cities and towns, and counties, must use state form of tax and state collection system.	Where legal, local control is good.	Local use taxes are administered by local government. Good control.	Statutory mill levy limits severely constrain local control in counties, statutory cities and towns, and districts. Oil company decisions will be very important in Garfield and Rio Blanco counties.
MARKET SIDE EFFECTS	Sets incentives for retail business location just outside of taxing jurisdiction.	Sets incentives for retail business location just outside of taxing jurisdiction.	Reduces incentives for retail business location just outside of taxing jurisdiction, especially with regard to autos and construction materials.	Disincentive to new market development. Could have an effect on development of oil shale resources.
CERTAINTY / PREDICTABILITY	Moderately good predictability in short run. Poor predictability over 3 to 5 year term.	Predictability depends on specific object of taxation. Good for motor fuels, tobacco products, and alcohol.	Same as general sales tax.	Good predictability of residential portion of tax base. Industrial and mining portions are more subject to erratic changes if production is unstable.
ADMINISTRATIVE COST	Largest administrative cost due to vendor fee. Total administrative cost--3-10% for home rule cities. 4-5% for counties and statutory cities and towns.	Somewhat higher than cost for general sales tax.	High. May approach 10% or more of revenue.	The cost of increasing or decreasing reliance on property tax is extremely small.
CITIZEN ACCEPTANCE	Opinions vary with existing level. Has consistently topped property tax in popularity surveys. Fractions of 1% may be preferred at times.	Opinions vary with existing level. High level of taxation on tobacco and alcohol expected. Existing levels throughout Colorado low compared to other states.	Strongly favored by local merchants selling major cost items located inside sales taxing jurisdiction.	Considered regressive and unfairly administered. Frequently comes in last in popularity in research opinion polls.

	GENERAL OCCUPATION TAX	SPECIFIC OCCUPATION TAX	USER FEES	SEVERANCE TAX
DESCRIPTION	Tax imposed for the privilege of carrying on any of a broad range of occupations within the taxing jurisdiction. Denver's head tax is an example.	Tax imposed for the privilege of carrying on certain occupations within a taxing jurisdiction. Utility occupation (franchise) taxes and beer and liquor occupation taxes are common in Colorado.	Prices charged the consumers of various public services such as water and sewer charges or recreation program charges. Fees may include charge for capital facilities as well as operating costs.	Tax on the production or extraction of certain minerals. Colorado's oil and gas production tax is a form of severance tax. It is levied on gross incomes derived from the production of certain types of oil and gas from Colorado deposits.
YIELD	The two most productive general occupation taxes in the state, Denver and Durango, raise roughly $20 and $4 per capita annually. May be collection lag with respect to economic growth.	All specific occupation taxes used by Colorado cities and towns together raise less than $3 per capita annually. Collection lag of up to one year is likely.	One-time initial fees (expansion or plant investment fees) and continued use service fees (monthly utility and recreation fees) may be designed to cover all or only a share of the cost of the capital facility and its associated operating costs. Collection generally follows initial capital construction but precedes expansion.	Colorado's oil and gas production tax allows a credit against certain ad valorem taxes paid by producers. A 5% severance tax on the gross proceeds from the sale of oil from oil shale is estimated to generate $3-1/2 million annually per 50,000 bbl/day operation, excluding tax credits. Multi-year revenue collection lag expected.
LEGALITY	Legal for home rule cities within charter limits. Legal for statutory cities/towns. No authority for counties, districts.	Legal for home rule cities within charter limits. Legal for statutory cities/towns. No authority for counties, districts.	Legal for all types of local governments.	No existing authority for this tax. The General Assembly could enable such a tax at the state, regional, or local level.
ELASTICITY	Strongly inelastic as typically used. Can be structured to be less inelastic.	Strongly inelastic as typically used. Can be structured to be less inelastic.	Strongly inelastic with respect to inflation. Unit elastic with respect to population growth and real income growth.	Changes in revenue from severance taxes are not correlated with changes in local economic conditions.
INCIDENCE	Where taxes are levied on firms doing business locally, same as general sales tax. Where tax is on exporting industry, it is exported outside of the region. A flat rate is regressive to individual income above any exemption level. Government employees exempt.	Same as general occupation tax.	Paid by the beneficiary of the service or facility. User fees ignore citizens' ability to pay. User fees can insure growth pays its own way.	Mining companies faced with severance taxes attempt to pass them along to customers or their labor force. In tight labor markets, more taxes will be passed on to consumers, thus exported from the region.
CONTROL	Excellent local control.	Excellent local control.	Excellent local control. Control as a revenue source is enhanced by the fact that increased costs due to increased demand are self-financing.	Very poor local control. The General Assembly sets the rates and non-local factors determine the size of the tax base.
MARKET SIDE EFFECTS	Significant side-effects unlikely at levels currently used in Colorado.	Heavy specific occupation taxes may discourage affected businesses from locating in the area and/or may result in price increases and negatively affect consumption.	Set incentives for the efficient use of public services since users pay for only the amount used. High initial fees for public facilities are reflected in higher housing costs.	Set incentives for the taxed activity to locate outside of taxing jurisdiction or not locate in the area at all. The higher the tax, the stronger the incentive. Effects can be much broader after mining activity is established in an area.
CERTAINTY / PREDICTABILITY	Very good predictability.	Very good predictability.	At fixed rate levels, good predictability. However, rate variations can be expected to affect consumption as well as costs.	Very poor certainty/predictability.
ADMINISTRATIVE COST	Depends on size of tax. At higher levels, the administration cost approximates general sales tax.	Depends on size of tax. At higher levels, approximates selective sales tax.	User fee revenue systems may give rise to substantial costs due to rate studies, monitoring, consumption, individual billing, and expanded accounting systems.	Very low.
CITIZEN ACCEPTANCE	May engender opposition as "new tax." Will have opposition from business community.	Citizens may feel they are being taxed at every turn. Businesses may argue that they are discriminated against.	Generally favorable. For low-income citizens, however, use of some public services may fall below a socially desirable level.	May be favorable if citizens feel energy consumers should share development costs and/or because severance taxes are largely exported.

	LOCAL INCOME TAX	REAL ESTATE TRANSFER TAX	SITE VALUE TAX	LAND VALUE INCREMENT TAX
DESCRIPTION	Tax on the income of resident individuals, estates, and trusts and income of non-residents derived from local sources. Also would apply to the incomes of corporations located in or doing business in the local area.	Tax levied on the conveyance of real property. The tax is analagous to a sales tax on real property.	Ad valorem tax on assessed valuation of land but not improvements.	Tax imposed on the net gain in the value of a given parcel of land or land with improvements between two points in time.
YIELD	For fiscal year 1972-73, Colorado collected in excess of $195 per capita in personal and corporate income taxes. A 25% local surcharge or a 1/2% flat rate would each raise approximately $25 per capita annually. Income tax collections are subject to multi-year lags from the occurance of economic activity.	Based on existing documentary fee collections, a 1% real estate transfer tax would produce $10-$15 per capita annually. Tax collections would tend to lead economic development.	15-20% of yield from identical mill levy on all real and personal property. Same time lag problem as with property tax.	Depends on exact nature of tax, but generally low in existing applications.
LEGALITY	A local income tax, levied by the General Assembly at the request of local political subdivisions, may be constitutional but unauthorized by statute.	Counties, statutory cities and towns, and special districts do not have express authority to levy a real estate transfer tax. The tax may be legal for home rule cities, but no court test has been made.	No authorization for statutory political subdivisions. May be legal for home rule cities. Does not appear to be prohibited by constitution.	Same as income tax.
ELASTICITY	Strongly elastic (range 1.3-2.0).	Generally elastic, yet subject to strong influence of money market conditions.	Same as property tax.	Highly elastic but subject to strong influence of money market conditions.
INCIDENCE	Graduated income taxes (State of Colorado) are strongly progressive with respect to income. Corporate income taxes are exported by export base industries. Income taxes bear lightly on elderly and low income people.	Conditions in real estate markets determine tax incidence. In a soft, buyers market, the seller will bear more tax burden than in a tight sellers market.	Landowners of all types. Less burden on occupants of high density residences.	Landowners in areas experiencing rapid increases in land value.
CONTROL	Because of the constitutional requirement that only the General Assembly may levy income taxes, rates would not be locally controlled. In the short run, tax base is outside local control.	Tax rate is subject to local control, but the tax base is influenced by non-local economic developments.	Statutory mill levy limits severely constrain local control in counties, statutory cities and towns, and districts. Oil company decisions will be very important in Garfield and Rio Blanco counties.	Very poor local control of rates (established by General Assembly) and tax base (sensitive to money market conditions).
MARKET SIDE EFFECTS	Significant market side-effects not identified.	Creates incentives to avoid property sales. In a tight market, housing prices will rise to cover tax cost. In a soft market, housing prices will be less affected. Such effects correlate to the tax rate applied.	Creates incentives to put land into its highest and best use allowed by law. Favors full development of area.	Reduces return to land speculation. Would inhibit exchange if applied to real rather than accrued gains. If applied to accrued gains, would provide incentive to put land into highest and best use.
CERTAINTY / PREDICTABILITY	Moderately good predictability in short run. Poorer predictability over 3 to 5 year term.	Poor certainty/predictability.	Very good predictability.	Unpredictable. More so if real gains are taxed, as opposed to accrued gains.
ADMINISTRATIVE COST	Very low for state-collected, locally returned local income tax.	Major cost is enforcement in major transactions. Generally low administrative cost. Lack of experience with this tax in Colorado suggests unknown administrative problems.	If land is assessed for property tax, little additional cost would result for site value taxation.	Administrative cost cannot be estimated due to lack of experience with this tax in the U.S. and because of the variety of forms of the tax.
CITIZEN ACCEPTANCE	Less favorable than federal income tax. Citizens can be expected to oppose a "new tax."	May engender opposition as "new tax," especially from realtors.	May engender opposition as "new tax" and since large rates are necessary to generate sizable revenues from small tax base.	Better acceptance if moderate gains accumulated over long periods were exempt. Tax on real rather than accrued gains would be more acceptable.

Source: Briscoe, Maphis, Murray, and Lamont, Inc., Oil Shale Tax Lead Time Study, prepared for Regional Development and Land Use Planning Subcommittee of the Governor's Committee on Oil Shale Environmental Problems, Denver, Colorado, 1974. This chart is a summary of Section 3 of that study.

the CEIP Model utilizes existing evidence, but it remains a relatively simple model of a very complex process. It should be treated as a useful guide and is probably as good as any existing alternative models, but weaknesses in the state of the art for forecasting industrial and fiscal impacts on local governments must be recognized.

V. ABSTRACTED BIBLIOGRAPHIES OF PRINCIPAL INFORMATION SOURCES

Advisory Commission on Intergovernmental Relations. SIGNIFICANT FEATURES OF FISCAL FEDERALISM 1976-1977, Vol. II. Washington, D. C., March 1977.

This report provides detailed information on the federal-state-local revenue and debt structures. The material includes major state and local tax rates and bases; major revenue producers of federal, state, and local finances; federal aid to state and local governments; state aid to local governments; and state and local government debt. This volume is intended to provide the data necessary for a comparison among states of alternative policies in the area of revenue and debt.

Braschler, Curtis, and John Kuehn. "Estimation of Employment Multipliers for Planning in Ozark Nonmetropolitan Counties." SOUTHERN JOURNAL OF AGRICULTURAL ECONOMICS, July 1976, pp. 187-192.

In determining employment multipliers for small areas, this study differs from previous approaches in two respects. The first difference is the grouping of counties by population. Statistical tests indicated estimation was improved by grouping based on population. This recognizes the importance of size in determining an area's secondary employment growth. Secondly, the regression analysis equation separated basic employment into sectors giving separate multipliers for each of the sectors. This recognizes the differences among basic sector impacts. Different industries produce different effects. The reported tables support findings of this and other studies which report significantly lower employment multipliers for nonmetropolitan areas than are projected by regional impact models. This article also notes multipliers should be adjusted to individual areas for more accurate community-specific estimates.

Garrison, Charles B. "New Industry in small Towns: The Impact on Local Government" National Tax Journal, 24, no. 4: 493-500.

This article reports the results of a study which analyzed the net impact of new industry on the local economy and government of five small towns in Kentucky.Regarding the public sector, the school districts received individual analysis. This was the only component of the public side which experienced a growth-related negative impact. And in only one town was the impact significant. Garison used two methods of assessing the impact on the local government. Some disagreement exists as to how the one-time or "transitory" costs (and revenues, if any) to the local government should be accounted for. These are the costs associated with plant location. The first calculation includes all costs and revenues. The second or alternate calculation in effect eliminates those one-time costs. Comparison with five control communities shows industry did affect significantly, the local economies, and in a positive way.

Gilmore, John S. and Mary K. Duff, Boom Town Growth Management: A case study of Rock Springs - Green River, Wyoming, Westview Press, Inc., Boulder, Colorado, 1975.

This book is the result of a case study of two communities experiencing "boom" or rapid growth. Gilmore and Duff found the economic and social framework within the communities were seriously affected. The housing market, public service provision, and stability of local labor supply were strained by the rapid growth, and unable to respond adequately to accomodate the increased demands. It was evident to the researcher that the traditional processes regulating economic growth were not operating well. The serious issue raised by the experiences with boom town growth is that of growth management. Following discussion of the "boom" phenomenon, growth management principals were presented. Identification of tools and methods of implementing objectives were included in that section.

Lonsdale, Richard E. "Two Commuting Patterns in North Carolina" _Economic Geography_, 42, no. 2: 114-138.

This article reports the findings of a study which compared and analyzed two commuting patterns of two manufacturing plants within the same community. Differences between the two patterns were observed and variables were introduced to explain the differences. Following the analysis and comparison of the two patterns, probability models based on gravity concepts were constructed using population and distance as the variables. Seven models using distance measures and five models using time measures tested the two variables' predictive power. The estimates of the models were compared with the actual distribution obtained in the fiber plant commuting pattern.

Lemont, William, George Beardsley, Andy Briscoe, John Carver, Dan Harrington, John Lansdowne and James Murray, Tax Lead Time Study, Colorado Geological Survey, State of Colorado Department of Natural Resources, Denver, Colorado, 1974.

This study presents the revenue sources available to the State of Colorado and its local governments. Included in the study is a discussion of the revenue alternatives and of techniques to deal with problems caused by rapid population growth. This study was prepared for the Regional Development and Land Use Planning Sub-Committee of the Governor's Committee in Oil Shale Enviromental Problems to provide recommendations for new legislation to improve the financing operations available to local governments. As stated in the preface, the intended users of this study are the local government officials, their staffs, citizens of the oil shale area, and the Colorado legislature.

Summers, Gene F. and Jean M. Lang "Bringing Jobs to People: Does It Pay?" Small Town, 7, no. 3: 4-11

This article provides a concise summary of important issues determining net impacts to the local private and public sectors. The summary of the issues presented here was taken from their book, "Industrial Invasion in Nonmetropolitan America". Direct employment hiring practices, employment multipliers, income effects, and population growth are discussed as they contribute to net impacts. The information and conclusions reported in the sections represent the work of over 100 case studies in 245 locations and 34 states. The conclusion is that the structure of the community, actions of the local public officials, and the character of the industry determine what impact industry will have on a community. Employment, population growth, and economic prosperity are not automatic and predictable gains to the host community.

Summers, Gene F., Sharon D. Evans, Frank Clemente, G. M. Beck and Jon Minkoff, Industrial Invasion of Nonmetropolitan America: A Quarter Century of Experience, Praeger Publishers Inc., New York, N. Y., 1976.

This book is the summary of 25 years of studies of specific plant locations in nonmetropolitan areas in the U. S. The purpose of this work was to determine the effects of industrialization on small towns. Several basic issues were addressed. One is the validity of procedures used with regard to nonmetropolitan industrial development as a tool for promoting the general welfare. Costs and benefits to the public and private sectors provided the framework with which to determine net impacts. The fact that this book presents local community experiences from the local perspective sets this study apart from previous studies, most of which analyzed impacts on the nonlocal private sector.

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NEW INDUSTRY IN SMALL TOWNS: THE IMPACT ON LOCAL GOVERNMENT

CHARLES B. GARRISON*

ABSTRACT

The establishment of new manufacturing plants in five rural towns in Kentucky typically resulted in a negative direct impact on local government finances. This impact was usually small, however, since most of the new plants added few new residents to the community and there was therefore very little increased demand for local government services. The school system was the unit of government most likely to be significantly affected; a large negative impact resulted if property taxes were substantially avoided and large numbers of new residents were brought to the community. The negative impacts tended to become positive after a few years.

NEW industry in rural areas is gaining increased acceptance as a solution for many of the nation's social and economic ills. Persons concerned with alleviating rural economic stagnation and poverty see the dispersion of manufacturing plants and jobs to the countryside as perhaps their best hope of making rural communities economically viable again. Those concerned with problems of the major cities see rural development as a way of reducing population pressures in urban areas. In addition, new industry is thought by many to be a solution to the problems of rural local governments. New industry, it is hoped, will produce new tax revenue. That new industry may also produce new costs for local government may be overlooked, however. This article reports the results of an effort to determine the conditions under which these additional costs may equal or exceed additional revenues. Further, the costs to local government are compared with the benefits accruing to the local private economy. The case study approach is used; the communities studied are five small towns in Kentucky in which new manufacturing plants located during the period 1958-63.

The local government impact is considered as two distinct effects — the primary and the secondary. The primary effect involves, on the one hand, the additional direct tax revenues derived from the new plant and, on the other, expenditures or changes in services by local government for the express benefit of, or directly attributable to, the new plant. The primary effect is summarized by the quantity "net primary benefits to local government." This quantity may be either positive or negative, and is given by the excess (deficiency) of the new firm's revenue effect over the expenditures effect. The secondary effect involves the impact of the plant's nontax expenditures on local government revenue, expenditures, and services.

The benefits of new industry to the local private economy also include a primary effect, i.e., the employment and payroll of the plant itself, and a secondary effect, i.e., the impact on the local consumption (or "nonbasic") sector of the community's economy.

An attempt was made to ensure that no major economic developments other than location of new manufacturing plants occurred in the study towns. Accordingly, the criteria used in selecting the study towns were that they be located outside Standard Metropolitan Statistical Areas, that they be small (a 1960 population between 1,000 and 5,000), and that at least one new plant employing at least 100 people had been established in the community during 1958-63. In addition, towns tied to the economies of neighboring larger cities were eliminated from consideration. The five communities selected are described in Table I. The new plants produced a variety of products, although three of the eight manufactured apparel of some type.

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TABLE I

DESCRIPTION OF STUDY TOWNS AND NEW MANUFACTURING ACTIVITY

Community	Population[a] (thousands)	Distance to Nearest Larger City[b] (miles)	New Plants		
			Number	Employment	Year Established
A	2.0	60	2	115	1959
				90	1962
B	4.0	87	1	100	1962
C	2.0	45	1	200	1959
D	4.8	62	3	135	1958
				100	1959
				140	1961
E	1.1	91	1	125	1959

[a]U. S. Census of Population, 1960.
[b]A city with a population of at least 50,000.

The economies of the five communities were characterized in 1958 by low incomes and high rates of unemployment or, more typically, underemployment in agriculture. Per capita incomes in the five study counties[1] ranged from $596 (29 per cent of the national average) to $995 (43 per cent of the national average). Agriculture typically was the largest single source of personal income, accounting for 30 per cent or more of total income in four of the five counties, but both average farm size and average value of farm products sold per farm were low. Manufacturing was a relatively unimportant source of income; in 1958 three of the five counties had fewer than 100 manufacturing employees.

I. *Net Primary Benefits to Local Government*

The direct effects of the new plants on local government revenues and costs are given in Table II. Only two of the eight new plants produced significant new revenue, i.e., revenue in excess of that yielded by the property prior to the plant location. In three cases the plant was owned by the city and was therefore not subject to real property taxes (A-2, B, and D-3). In these cases the cities issued industrial revenue bonds and with the proceeds purchased the plant sites and constructed the plant buildings. The manufacturing firms make monthly rental payments to the cities sufficient to cover principal and interest payments on the bonds. In two cases "favorable assessments" on real property resulted in minimal revenue (C and E). The three plants in Community D were located outside the city limits and were not subject to city taxes.

The amount and cost of new public services attributable to location of the new plants depended in large measure on the number of new residents brought to the community. New residents mean new school children, and if the previous level of local support is to be maintained, additional revenue is required.[2] It is also the new residents who force expansion in fire and police protection and other basic services, if they are needed. A community may also incur a cost in providing services directly to the plant itself, such as provision of water services or traffic control.

In six of the eight cases reported here, additional costs to local government exceeded additional revenue, i.e., net primary benefits were negative. The additional costs

[1]"Study town" and "study county" are used somewhat interchangeably as an economic unit. It is difficult to separate small rural towns from the county; further, some local government units affected by new industry are countywide (county governments and school districts).

[2]This approach was taken in a study of suburban communities by Louis K. Loewenstein. "The Impact of New Industry on the Fiscal Revenues and Expenditures of Suburban Communities," *National Tax Journal*, XVI (June 1963), pp. 113-136.

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Community and Plant	Addit Reve
A-1 (Average, 1960-63)	$2,5
A-2 (1963)	
B-1 (1963)	—
C-1 (Average, 1960-63)	
D-1 (1963)	1ε
D-2 (Average, 1960-63)	—51
D-3 (Average, 1962-63)	5
E-1 (Average, 1960-63)	—
Total	$2,8C

[a]Does not include a cost to t
The expenditure was made from
city voters in 1957, and represent
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an increase of 25 students
school system. The remainir
locations involved the transfe
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TABLE II

ANNUAL NET PRIMARY BENEFITS TO LOCAL GOVERNMENT OF NEW MANUFACTURING PLANTS, FIVE RURAL COMMUNITIES IN KENTUCKY

Community and Plant	Additional Revenue	Cost of Additional Services	Net Primary Benefits
A-1 (Average, 1960-63)	$2,505	$ 2,675	$ —170
A-2 (1963)	28	3,400	—3,372
B-1 (1963)	—24	511[a]	—535
C-1 (Average, 1960-63)	54	953	—899
D-1 (1963)	187	0[b]	187
D-2 (Average, 1960-63)	—517	1,320[c]	—1,837
D-3 (Average, 1962-63)	530	1,200[d]	—670
E-1 (Average, 1960-63)	42	0	42
Total	$2,805	$10,059	$—7,254

[a]Does not include a cost to the city government of $92,000 assigned entirely to the year 1962. The expenditure was made from the proceeds of a tax-supported industrial bond issue approved by city voters in 1957, and represents the donation of the plant site and the construction of an elevated water tank and sewage disposal plant on the site.

[b, c, d]Does not include one-time costs to the city of $1,200, $8,000, and $10,000, respectively, for the extension of water lines.

Source: Municipal, county, and company records and interviews.

were largely due to the addition of new students to the local school systems. However, the typical plant location studied here resulted in few new residents in the community, and therefore very little increased demand for public services, including education. Indeed, a major location factor in each case was the availability of an adequate local labor force. The largest number of new residents, and accordingly the largest cost to local government, occurred in Community A, where each of the two companies brought in 15 managerial and supervisory employees. Company officials estimated that each plant accounted for an increase of 25 students in the local school system. The remaining six plant locations involved the transfer of only 19 new employees and a total of 27 new students. The small number of new residents had important implications for local government: the direct effect on public expenditures as well as revenues was typically small. Thus, whether net primary benefits were negative or positive, they were likely to be small.

The impact was by no means uniform among the several units of local government studied. The units most susceptible to a negative effect were the school districts (Table III). To estimate the cost of new students, it was assumed that the cost to the school district of educating an additional student without reducing the quality of education received by other students is equal to the average local revenue per student. It might be argued that, with the exception of Community A, the num-

TABLE III
ANNUAL NET PRIMARY BENEFITS OF NEW MANUFACTURING PLANTS, BY TYPE OF LOCAL GOVERNMENT UNIT, FIVE RURAL COMMUNITIES IN KENTUCKY

Community and Plant	County	School District	City
A-1	$ 370	$—1,563	$ 1,025
A-2	9	—2,380	—1,000
B-1	—6	—18	—511
C-1	8	—197	—709
D-1	52	135	0
D-2	—144	—1,693	0
D-3	148	—818	0
E-1	18	23	1
Total	$ 455	$—6,511	$—1,194[a]

[a]"One-time" costs omitted from calculation; see Table II footnotes.
Source: Municipal, county, and company records and interviews.

ber of new students was so small that they could be absorbed without diluting the quality of education. Indeed, alternate treatments could be defended for a number of revenue and expenditure items entering into the calculation of net fiscal impact. These ambiguities in large part disappear, however, if the calculation is made for a later year. Such an "improved" calculation is shown in Table IV, which differs from Table II in the following respects:

1. Tax concessions initially granted by local government but later removed result in larger revenue effects. Specifically, real property assessments were increased substantially for plants C-1, D-1, and E-1. In the opposite direction, correction of an assessment error discovered in 1966 reduced the revenue yielded by plant A-1.

2. An alternate treatment of the revenue calculation is accorded plant D-2. This firm moved into a building previously occupied by a manufacturing concern which had left the community in 1957. When the new firm acquired the property, the assessment was reduced, apparently reflecting the purchase price. It may reasonably be argued that the resulting decline in tax revenue should not be attributed to location of the new firm but to the loss of its predecessor. Accordingly, Table IV treats the total taxes paid by the new plant as "additional revenue."

3. The cost of new students, except in Community A, is considered to be zero. The costs which remain are those representing actual outlays which will recur well into the future. The effect is to eliminate from consideration one-time costs incurred at the time of plant location (in cases B-1, D-1, D-2, and D-3). Further, in case C-1 an annual outlay incurred by the city was completed in 1968.[3] In the other direction, the cost associated with plant A-2 was increased in 1965 by a further addition of 15 new residents and 20 new school children.

The alternate calculation to a considerable extent removes from the analysis the "transitory" cost and revenue effects, i.e., those associated with the actual plant location process or applicable for only a limited time period following the plant location. By this calculation modest gains accrue to three of the communities and only in Community A is there a significant negative impact. Community A was the only study town receiving a sizeable number of new residents; payment of all taxes by plant A-1 was not sufficient to offset the added cost of new students.

II. *Benefits to the Local Economy*

Small towns which recruit new industry obviously consider the stimulus to the local

[3]The "one-time" cost of $92,000 incurred by the city in case B-1 might be considered an annually recurring cost in the amount of the tax required to support the industrial bond issue. At any rate, the bond issue was retired, and the supporting tax was eliminated, in 1966; accordingly, no cost is assigned to the post-1966 period.

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Community and Plant	A
A-1 (1966)	
A-2 (1965)	
B-1 (1967)	
C-1 (1968)	
D-1 (1964)	
D-2 (1964)	
D-3 (1964)	
E-1 (1967)	
Total	

Source: Municipal, county, an

private economy as the major derived. It is of interest, the an estimate of such benefits studies reported here. Table estimated impact of the ne personal income in the five (where the unit of study i county). The total impact c components: (1) the direc effect, which represents the i community's basic income, secondary effect, which repr crease in nonbasic income.

The distinction between " and "nonbasic income" der concept of an economic ba income of a community is e activities which export good to other areas.[4] Nonbasic in other hand, is earned in the l tion sector of the county's e sector is dependent on the cally of basic income. The in income here attributed to ne measured by the 1963 plan the earnings of employees w from other counties. The to income due to new industr the community income multi new industry payroll accru

[4]Basic activities in the count include agriculture, mining, mar in some cases, certain other com retail and services income assoc ism, income earned by county re ing to jobs outside the county, a ments.

TABLE IV
ANNUAL NET PRIMARY BENEFITS TO LOCAL GOVERNMENT OF NEW MANUFACTURING PLANTS, FIVE RURAL COMMUNITIES IN KENTUCKY: ALTERNATE CALCULATION

Community and Plant	Additional Revenue	Cost of Additional Services	Net Primary Benefits
A-1 (1966)	$1,655	$2,675	$—1,020
A-2 (1965)	29	5,360	—5,332
B-1 (1967)	—24	0	—24
C-1 (1968)	875	0	875
D-1 (1964)	906	0	906
D-2 (1964)	1,667	0	1,667
D-3 (1964)	530	0	530
E-1 (1967)	1,285	0	1,285
Total	$6,922	$8.035	$—1,113

Source: Municipal, county, and company records and interviews.

private economy as the major benefit to be derived. It is of interest, then, to provide an estimate of such benefits in the case studies reported here. Table V gives the estimated impact of the new plants on personal income in the five communities (where the unit of study is actually the county). The total impact consists of two components: (1) the direct or primary effect, which represents the increase in the community's basic income, and (2) the secondary effect, which represents the increase in nonbasic income.

The distinction between "basic income" and "nonbasic income" derives from the concept of an economic base. The basic income of a community is earned in those activities which export goods and services to other areas.[4] Nonbasic income, on the other hand, is earned in the local consumption sector of the county's economy. This sector is dependent on the respending locally of basic income. The increase in basic income here attributed to new industry is measured by the 1963 plant payroll, less the earnings of employees who commuted from other counties. The total increase in income due to new industry is equal to the community income multiplier times the new industry payroll accruing to county residents. The estimated multipliers for communities A through D are, respectively, 1.46, 1.73, 1.43, 2.02, and 1.26.[5] The interpretation is that, in Community A, an increment of $100 in new industry wages paid to local residents led to an increase of $46 in nonbasic income.

The secondary impact on employment was relatively smaller than that on income. For the five counties combined, employment of the new plants was 1,517 in 1963, 1,177 of whom were county residents. But the associated increase in nonbasic employment was estimated as only 98 jobs. This estimate involved calculating for each county the ratio of the increase in basic income "required" to generate one additional nonbasic job. For example, in Community A an increase of $30,830 in basic income during the study period was required per additional nonbasic job. The implication for new industry is that for each $30,830 in annual wages paid to county residents, one additional job was created in the county's nonbasic sector.

Apparently the small secondary effect on

[4]Basic activities in the counties studied here include agriculture, mining, manufacturing, and, in some cases, certain other components such as retail and services income associated with tourism, income earned by county residents commuting to jobs outside the county, and transfer payments.

[5]The multiplier for a county was calculated as the ratio of the total increase in annual income to the increase in annual basic income, with 1958 serving as the base year and 1963 as the terminal year. Calculation of the multiplier thus involved separating the county's personal income into basic and nonbasic components. While subject to serious limitations if applied to complex economies, this type of analysis appears well suited to small economies characterized by a minimum of interindustry relationships.

TABLE V
ESTIMATED IMPACT OF NEW INDUSTRY ON COUNTY INCOME, 1958-63, FIVE RURAL COMMUNITIES IN KENTUCKY

Community	Increase in Basic Annual Income	Increase in Nonbasic Annual Income	Total Impact on Annual Income
	(Thousands of dollars)		
A	1,007	466	1,473
B	326	238	564
C	663	287	950
D	1,076	1,098	2,174
E	463	120	583
Total	3,535	2,209	5,744

Source: Author's estimates.

employment is explained by underutilization of employees in the local consumption sector prior to the location of the new plants. This sector could then accommodate increased sales without a commensurate increase in employment. This explanation is supported by the minor role of the construction industry in the secondary impact (13 of 98 new nonbasic jobs); apparently the communities' capital stock was also underutilized. The lack of a significant effect on nonbasic employment is demonstrated further by the fact that the income multiplier effect on wage and salary income was smaller than the effect on proprietors' and property income.

III. *Secondary Impact on Local Government*

The calculation of new industry's effect on local government has considered only the direct or primary impact, while it was pointed out that the impact on the local private economy consisted of both a primary and a secondary effect. The possibility thus exists that the multiplier effect on the nonbasic sector might result in a significant secondary effect on local government revenues or expenditures.

The evidence suggests that such an effect in the five case studies reported here, if it exists at all, is quite limited. As noted above, the economic impact did not include a population increase; the new plants themselves brought in very few new residents, and the relatively small employment expansion in the local consumption sector doubtlessly also came from the local labor force. (Population estimates indicate a decline of 2.9 per cent for the five counties during the 1958-63 period.) Further, analysis of construction industry data and interviews with local businessmen indicated very little investment in new business or residential construction during the study period. One would thus expect a net secondary effect on local government of no increase in the demand for local government services and little or no increase in the revenues, since the local revenue base was dominated by the assessed value of real and personal property.[6] This conclusion tends to be supported by an analysis of local government data covering the five study communities and a group of five "control" communities which had similar economic characteristics but did not receive new industry (Table VI). For all local government units combined, the relative increase in direct general expenditures from 1957 to 1962 was somewhat greater in the study communities than in the control group, but the range of increases within the groups was even larger. And if the analysis is extended to 1967, the percentage increase in expenditures was actually larger in the control group. There

[6]At the state government level, Legler and Shapiro have observed that the responsiveness of revenue to economic growth of a particular tax varies according to whether the income increase is due to per capita improvement or to population growth. See John B. Legler and Perry Shapiro, "The Responsiveness of State Tax Revenue to Economic Growth," *National Tax Journal*, XXI (March 1968), pp. 46-56.

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Source: For I, U. S. Bureau 36, and VII (1962 *port of Superintend* cation), XXVII (For III, Kentucky For IV, Municipal

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IV. *Summary and Conclus*

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TABLE VI
COMPARISON OF STUDY AND CONTROL COMMUNITIES: CHANGE IN LOCAL GOVERNMENT REVENUES, SERVICES, AND EXPENDITURES

	Study Communities		Control Communities	
Item	Change	Per cent Change	Change	Per cent Change
I. *All Local Government Units (1957-62)*				
General revenue ($1,000)	2,638	57.0	1,932	55.0
Per capita	$ 35	61.2	$ 33	60.0
Direct general expenditures ($1,000)	2,998	66.6	1,955	58.0
Per capita	$ 39	70.2	$ 33	62.2
Employment	31	2.5	141	16.0
II. *School Districts (1959-64)*				
Enrollment	—359	—1.8	—411	—2.6
Number of teachers	—1	—0.1	—3	—0.5
Full market value of taxable property ($1,000)	78,483	32.1	50,787	39.4
Local revenue ($1,000)	103	7.4	78	10.6
III. *County Governments (1959-64)*				
Operating expenditures ($1,000)	191	34.0	98	25.4
IV. *Municipal Governments (1958-63)*				
Assessed value of property ($1,000)	2,437	15.6	n.a.	n.a.
Property tax revenue ($1,000)	18	13.6	n.a.	n.a.
Total revenue ($1,000)	167	49.7	n.a.	n.a.
Expenditures ($1,000)	131	39.9	n.a.	n.a.

n.a. Not available
Source: For I, U. S. Bureau of the Census, Census of Governments: Kentucky VI (1957), Table 36, and VII (1962), Tables 27 and 28. For II, Kentucky Department of Education, *Report of Superintendent of Public Instruction,* (Frankfort: Kentucky Department of Education), XXVII (1959) and XXXIII (1964) and Kentucky Department of Revenue. For III, Kentucky Auditor of Public Accounts, "Report on Examination," 1959 and 1964. For IV, Municipal records of the five study communities.

is some evidence of relatively greater dependence on nonlocal sources of revenue by the control communities during the study period. This is perhaps explained by the fact that incomes were lower in these counties than in the study group. The analysis of the private economic impact indicates that about 15 per cent of the per capita income difference between the two groups as of 1963 was attributable to the study communities' new manufacturing plants.

IV. *Summary and Conclusions*

The establishment of new manufacturing plants in five rural towns in Kentucky during the period 1958-63 typically resulted in a negative direct impact on local government finances. Of equal importance, however, this impact, summarized in the quantity "net primary benefits to local government," was usually small. Most of the new plants studied here added few new residents to the community; the availability of local labor was in fact a major reason for the locations. For this reason there was very little increased demand for local government services, and this factor served to keep the magnitude of negative impacts relatively small. A large negative impact resulted for the school system only if property taxes were substantially avoided and significant numbers of new residents (and school children) were brought to the community. A sizeable negative impact on the municipal government occurred if a large nontax inducement (e.g., provision of water or sewer services or donation of land) was combined with property tax avoidance.

There was a tendency in the towns studied here for the negative impact to be converted into positive net primary benefits (although rather modest in magnitude) a few years after the plant location. A variety of reasons accounted for this result, including (1) the elimination of tax concessions in the form of low property assessments granted at the time of location; (2) the fact that some costs incurred by municipal governments are applicable to only the year in which the new plant was established or are amortized over a relatively few years; and (3) more rarely, the later imposition of new types of taxes, such as occupational taxes applicable to the employees of new industry.

Whether net primary benefits to local government are calculated for the period immediately following plant location or for a later period, and whether they are positive or negative, they tend to be very small relative to new industry's benefits to the local private economy. These benefits were calculated to include both the primary impact (i.e., the plant payroll) and the secondary impact (i.e., the increase in income induced by local spending of the plant payroll). The total impact on the private economy, as measured by the increase in county personal income, ranged from $564,000 per year to $2,174,000. This may be compared with negative net primary benefits to local government ranging from $535 to $6,352 per year, or with "one-time" costs incurred at the time of plant location limited to $10,000 or less, except in one case in which $92,000 was expended.

The secondary impact on local government was apparently quite small, if indeed it existed at all. This conclusion is suggested by comparing local government revenues, expenditures, and services in the study communities with those in five rural communities which did not attract new industry during the study period, and by interviews with local civic leaders, who contended that the new plants had placed no strains on local government services. As further indirect evidence of the adequacy of local public facilities and services, each of the study towns was seeking further new industry at the time of the study, and three (communities B, C, and D) had already succeeded. New industry attracted to small rural towns mainly by the availability of local labor does not produce significant population growth; a small impact on local government services is therefore not surprising.

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ABSTRA(

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Introduction

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*University of Massachuset

[1]Charles A. Reich, "The N
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Bringing Jobs to People: Does It Pay?

by GENE F. SUMMERS and JEAN M. LANG

This article was prepared by Gene F. Summers, Professor of Rural Sociology, University of Wisconsin-Madison, and Jean M. Lang, Editor and Science Writer, Institute for Environmental Studies, University of Wisconsin-Madison. It is based upon material in Gene F. Summers, Sharon Evans, Frank Clemente, Elwood M. Beck, Jr. and Jon Minkoff, *Industrial Invasion of Nonmetropolitan America;* Praeger, 1976.

The University of Wisconsin Department of Rural Sociology issues a semi-annual list of "Publications in Print." Many of these deal with applied programs in Wisconsin, others with specific studies in community development and rural industrialization related to problems discussed in this article. For a copy of the publications list, write Gene Summers at the Department of Rural Sociology, 603 WARF Building, University of Wisconsin, Madison, Wisconsin, 53706.

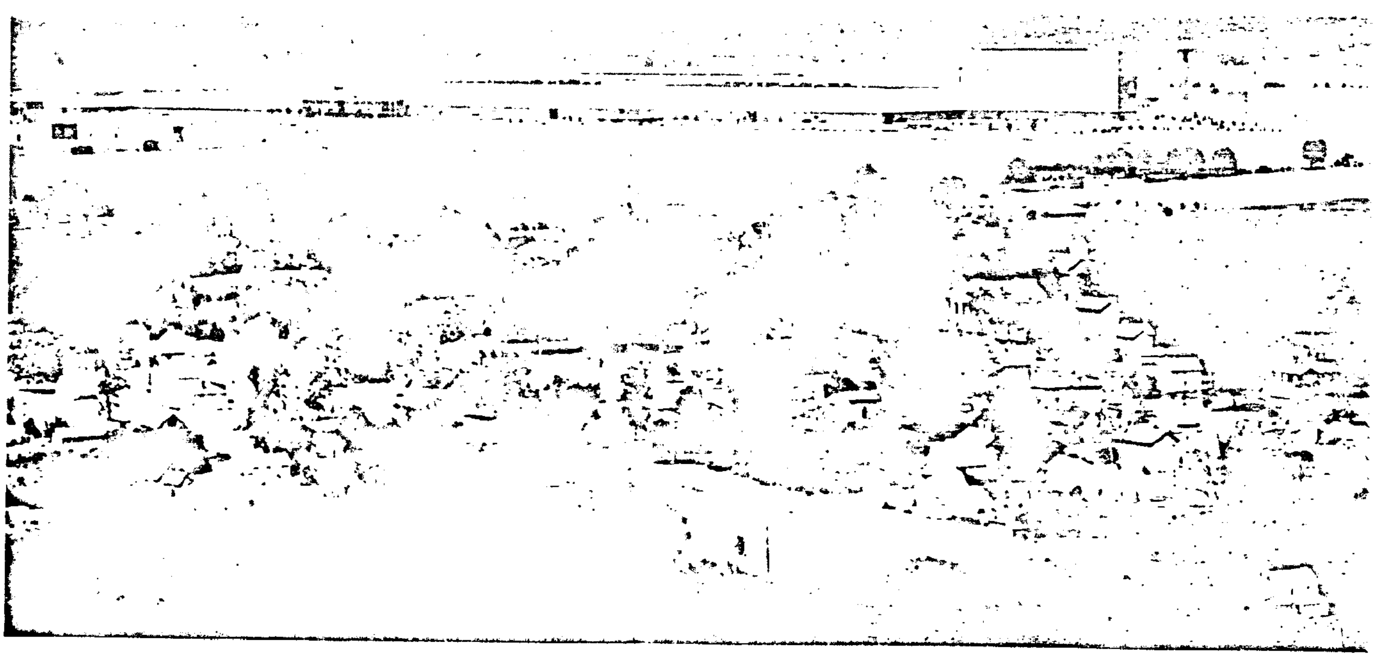
Over the last twenty-five years manufacturing industries have been moving out of the city and into the countryside at an ever increasing rate. Between 1960 and 1970 manufacturing employment in nonmetropolitan areas grew by 22 percent while manufacturing jobs in metropolitan areas grew only four percent.

Industries have had their own reasons for expanding into rural areas: lower local taxes, cheaper land and water costs, and a good supply of laborers, presumably steeped in the American work ethic.

Industry's interest in rural factory sites has been strongly encouraged by the eager solicitations of potential host communities and by federal policy. For example, nonmetropolitan location of industry has been an explicit goal of recent federal anti-poverty legislation including the Economic Opportunity Act of 1964, the Public Works Act of 1965, the Appalachian Regional Act of 1965, and the Rural Development Act of 1972.

The apparent logic behind this interventionist strategy is fairly simple. Both rural poverty and urban socioeconomic problems are seen as products of a geographic mismatch of labor supply and demand. The mismatch has been caused by a decline in economic opportunities in rural areas and an increase of the same opportunities in urban areas. One means of correcting this imbalance is to stimulate the rural economy, thereby increasing job opportunities and halting the exodus of rural labor to the city.

An industry, particularly a manufacturing plant that generates a direct flow of money to the local community, is considered an ideal stimulus for the rural economy. Indus-



This aerial photo shows the village of Hennepin, Illinois, and the Putnam County Court House (center, right) – the oldest in continuous use in Illinois – with a new Jones & Laughlin Steel plant in the background. The plant produces cold rolled and galvanized steel sheets. This, and the photo on page 10 are courtesy of the Jones & Laughlin Steel Corporation.

try's presence is expected to spark income growth, population redistribution, housing improvements, better community services, and other amenities. It is exactly these presumed benefits that make large industry so attractive to the small community. But are these benefits being delivered? Do rural communities really profit from industry's arrival, or are there undesirable side effects?

In a study sponsored by the Economic Development Administration, U.S. Department of Commerce, a team of sociologists attempted to answer these questions.[1]

Our group reviewed almost 100 case studies of the impacts of industrial location on nonmetropolitan communities. The case studies encompassed more than 700 manufacturing plants in 245 locations and 34 states. The predominant industries were metals production and fabrication, chemicals manufacture and wearing apparel assembly. The factories ranged in size from those with less than ten workers to plants with over 4,000 employees. The majority of factories were located in the Midwest and the South.

Although the studies included a great diversity of industries and locations, they did not constitute a representative sample and should be judged accordingly.

Employment - Direct Hiring

There is no question that industry brings new jobs to a community. Some of the jobs come from direct hiring of plant personnel, and others follow indirectly as the new industry stimulates growth in existing sectors of the local economy. The important question is who gets the new jobs.

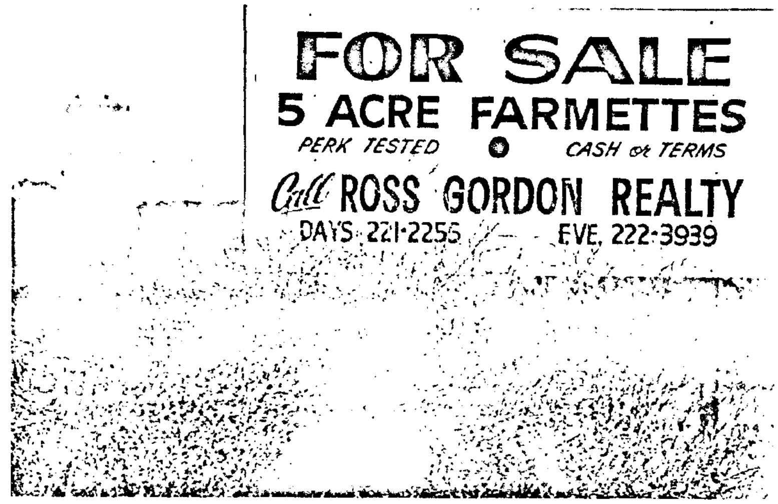
Our study revealed that new factories generally *did not* hire the local unemployed. In the majority of cases only a small portion of the jobs were filled by local disadvantaged or unemployed persons (Table 1). There was also considerable evidence that nonwhites were underrepresented in rural factories.

There appeared to be two primary reasons why local poor, minorities and disadvantaged were infrequently hired:

First, the labor pool for a rural industry extends well beyond the area of the host community. Long distance commuters are not uncommon, and the new factory generates considerable in-migration and settlement of workers from the surrounding area (Table 2). From this widespread labor force, industry selects the better educated, more highly skilled worker with the "right" racial heritage. The local unskilled resident often has little hope of qualifying.

Second, many jobs are taken by newcomers to the labor force, primarily women. Many rural industries, particularly textiles and electronics assembly, prefer female labor. Thus previously nonworking women fill the factory jobs. This increases the number of people in the labor force but does not decrease the number of unemployed workers in the community.

Ironically, it is possible for new industry to reduce unemployment and poverty in a community without providing a



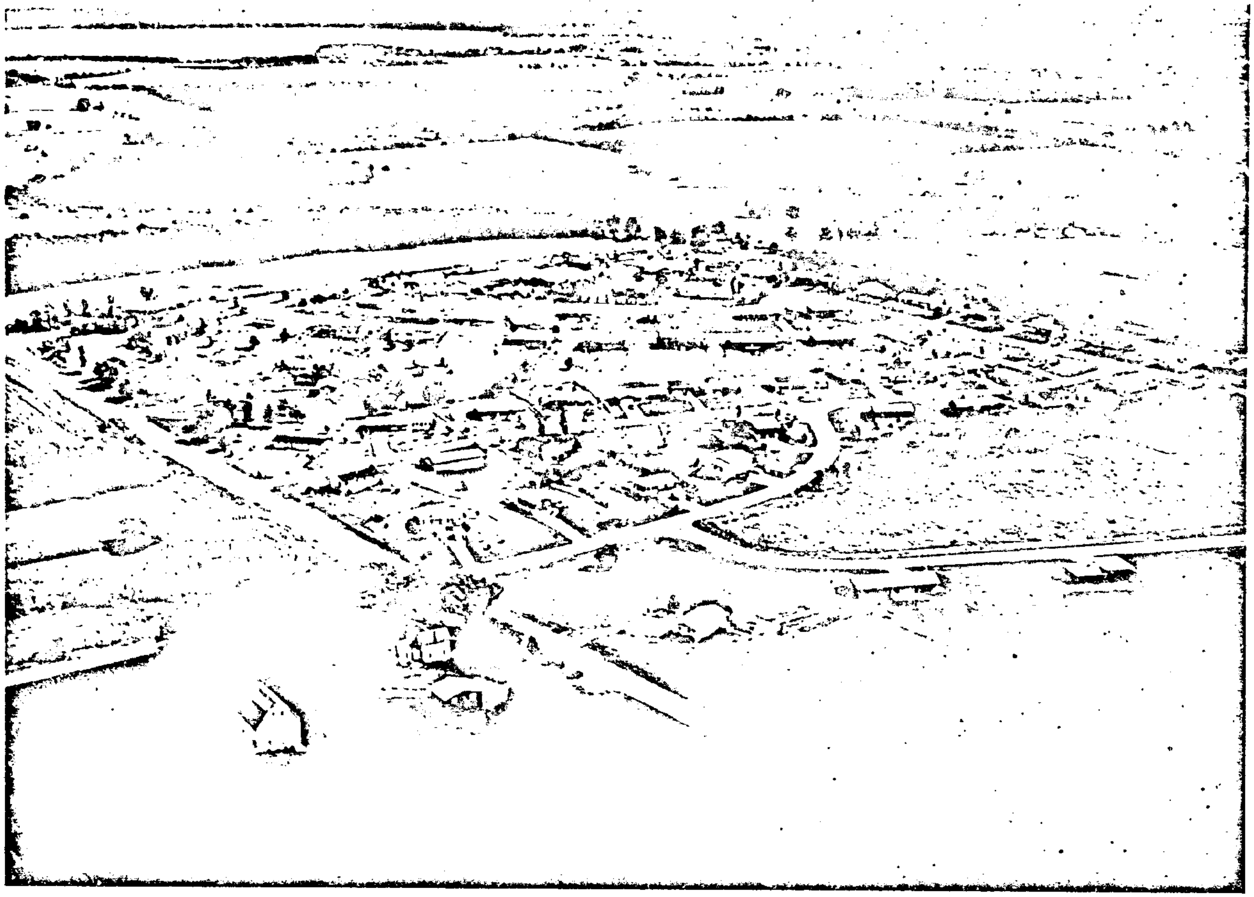
Zoning laws prohibit subdividing farms in this Wisconsin township so developers get around this rule by creating 5-acre "farmettes." University of Wisconsin photograph by Jim Larison.

Table 1
Percentage of New Plant Workers Previously Unemployed

Study Site	*Industry*	*No. of Jobs*	*% of Jobs Filled by Previously Unemployed*
Linton, Ind.	Aluminum chairs	100	25.0%
Wynne, Ark.	Apparel; copper tubing	1,900	11.2
Rochester, Minn.	Business machines	1,862	14.0
Ravenswood, W. Va.	Aluminum	894	11.0
E. Oklahoma Comm.	12 plants (mixed)	554	7.7
A.R.A. Area Survey	33 plants (mixed)	1,262	43.0
Mt. Airy, N. C.	Appliances	435	8.0
Jefferson, Ia.	Stamping, athletic equipment	369	3.0
Orange City, Ia.	10 plants (mixed)	364	19.0
Creston, Ia.	Appliance, chemicals, oil filters	424	1.0
Grinnell, Ia.	Farm machinery, stadium bleachers, plastics	200	7.0
Decorah, Ia.	Screws; undetermined	212	8.0
Star City, Ark.	Apparel (shirts)	336	9.5

Table 2
Proportion of Plant Workers Migrating to Take New Employment

Census Region	*No. of Studies*	*Average Percent*
North Central	6	32
South	4	32
West	1	18
All Regions	11	30



An example of the encroachment of housing developments on agricultural land. Photo courtesy of Jim Larison, University of Wisconsin.

single job to the disadvantaged who live there. Although the labor force may expand faster than the ranks of the unemployed, the absolute number of persons in economic distress may be unchanged or slightly increased (Table 3). In general, the case studies showed that the operations of the local labor market often work against the needs of the people for whom rural industrial development has been allegedly promoted.

Employment - Multiplier Effect

Besides hiring local workers for its factory, new industry is expected to generate secondary jobs in the retail, wholesale and service trades of the host community. This indirect effect on employment is called a "multiplier." A multiplier of 1.0 means the industry brings no new jobs except those by direct hiring. A multiplier of 1.65 means that for every new job in the factory, another .65 job is created within the community.

A significant finding of the case study review was that the majority of industries in the rural community had a multiplier effect of *less than 1.2*. Several reasons were given for these low multipliers:

First, the less diversified the existing manufacturing, commercial and service industries are, the less impact the new industry will have on local economy.

Table 3
Unemployment Rates Before and After Industrial Development

Study Sites	Dates Before	Dates After	Rates (%) Before	Rates (%) After	Change
Jackson Co., Ia.	1950	1960	1.8	3.7	+1.9
Cross Co., Ark.	1960	1970	5.2	4.6	-0.6
Washington Co., Miss.	1950	1963	10.1	4.2	-5.9
Box Elder Co., Utah	1955	1965	6.7	7.0	+0.3
Putnam, LaSalle and Bureau Co., Ill.	1966	1973	3.6	5.0	+1.4
Adair Co., Okla.	1960	1970	16.4	17.5	+1.1
Cherokee Co., Okla.	1960	1970	16.2	10.0	-6.2
Muskogee Co., Okla.	1960	1970	8.9	7.4	-1.5
Hot Springs Co., Ark.	1958	1970	11.9	7.0	-4.9
Baxter Co., Ark.	1964	1970	8.2	4.7	-3.5
Howard Co., Ark.	1960	1970	4.3	3.9	-0.4
Logan Co., Ark.	1958	1970	15.6	6.8	-8.8
Randolph Co., Ark.	1964	1970	9.4	9.3	-0.1
Benton Co., Ark.	1960	1970	5.5	4.5	-1.0
White Co., Ark.	1960	1970	12.1	12.1	0.0
Laurel Co., Ky.	1960	1963	12.6	7.1	-5.5
Lamar Co., Texas	1952	1962	6.0	5.2	-0.8

Second, commuters, who generally make up a substantial part of the rural factory work force, often spend their salary in their place of residence rather than their place of work. Much of the factory income "leaks out" of the host community.

Third, many small towns already have excess underutilized business capacity. As a result, the firm can handle industry-induced increases in sales without hiring additional workers or enlarging their capital stock.

Fourth, many industries are linked by a national network to outside suppliers and processors and have no need to draw upon local services or products.

At worst, the local community may become little more than a labor source for the factory with virtually no indirect or induced employment.

Four often cited studies (nos. 15, 16, 17, and 18 in Table 4) that depict nonmetropolitan industry with a multiplier of 1.5 or more were closely examined by the review team. In each of the studies it was found that only those rural counties had been selected that had relatively large manufacturing sectors (more than 15 percent of total employment) and were undergoing rapid and substantial economic growth. According to these criteria, only 30 counties in the entire U.S. qualified in 1970.

Income

Industrialization of the rural area does bring an increase in average income over a period of time. The case studies showed that average increases in individual income varied from 5.3 to 183.0 percent, and average family income increases ranged from 25.6 to 178.4 percent. However, in most cases both family and individual income increases were less than 50 percent.

Three factors were largely responsible for the frequent cases of relatively small income growth:

* Small income increases were usually associated with lower wage industries such as wood, textiles and apparel.
* Industries importing raw materials into the area and exporting products out of the area created smaller secondary income effects as discussed above.
* A substantial amount of commuting by nonresidents into an area for work, and by residents out of an area to shop, reduced the size of income growth.

Significantly, of the numerous case studies on industry's impact, very few had considered how income growth is distributed throughout the population. Of those studies which did examine this factor, all suggested that certain sectors of the population receive no benefits from industrial development. Indeed, for groups such as the elderly and blacks, industrialization often has negative effects. As the community's standard of living rises, prices go up and the purchasing power of these disadvantaged groups decreases.

In addition, several of the impact studies showed that the greatest gain in benefits went to newcomers in the com-

Table 4
Employment Multipliers

	Study Site	*Unit of Analysis*	*Research Time Period*	*Industrial Product*	*Direct Employment*	*Employment Multiplier*
1.	Linton, Ind.	City	1964	Aluminum chairs	119	1.02
2.	Gassville, Ark.	8-County Area	1960-63	Shirt plant	750	1.11
3.	Summerville, S. C.	4-County Area	1963	Brick factory	25	1.36
4.	Pickens, Miss.	4-County Area	1964-65	Tissue paper mill	57	1.14
5.	Braxton Co., W. Va.	County	1963	Particle board plant	77	1.50
6.	Hart Co., Ky.	County	1963	Bedding plant	111	1.06
7.	Fleming Co., Ky.	County	1958-63	Auto & appliance trim, shoes	328	1.11
8.	Laurel Co., Ky.	County	1958-63	Yarn	107	1.18
9.	Lincoln Co., Ky.	County	1958-63	Apparel	380	1.00
10.	Marion Co., Ky.	County	1958-63	Barrels, Communications equipment, Apparel	496	1.11
11.	Russell Co., Ky.	County	1958-63	Apparel	206	1.03
12.	Howard Co., Ind.	County	1949-60	All manufacturing	4,006	1.44
13.	Box Elder Co., Utah	County	1955-61	Chemicals	5,688	1.34
14.	Lawrence Co., Tenn.	County	1954-63	Bicycles	2,270	1.36
15.	Select U.S. Counties	11 Counties	1950-60	All manufacturing	17,116	1.65
16.	Select U.S. Counties	10 Counties	1960-70	All manufacturing	25,677	1.68
17.	Leflore Co., Miss.	County	1959-64	All manufacturing	1,430	1.59
18.	White Co., Ark.	County	1951-59	All manufacturing	590	1.71

munity rather than to the original residents. This suggests that the people who bear the cost of the development (by increased taxes for land development, for example) may not be the *same* people who will capture the benefits and in fact they may find themselves in a *worse* relative position after development than before.

The question arises as to whether industrial development is a desirable community goal simply because it may marginally increase *average* income. The basic issue boils down to whether growth in "community" well-being should be purchased at the expense of the disadvantaged.

Population Changes

Does industrial development halt population decline in small towns or rural communities? The answer is unequivocally, yes.

All case studies dealing with industry's impact on rural population showed that the rate of population decline had been slowed, halted, or—as in the majority of cases—reversed after industry's arrival. However, the studies also made it clear that most population growth was based on an increased migration of workers into the area.

In eleven case studies, an average 30 percent of factory workers had moved into the host communities to take their jobs. The majority of these workers had originally commuted to the factory from neighboring areas within a radius of 50 miles. Eventually, however, as the workers became more settled and secure in their jobs, most of them moved into the host community or nearby towns. Exceptions to this trend occurred when a county had well-developed transportation and educational systems, as well as a surplus of labor. In such instances, employees preferred to commute rather than move to town.

The population growth that accompanied industrialization was found to be centered in the factory town rather than being spread throughout the country. In almost all cases, the population in the host town increased while the rural and farm population of the surrounding area decreased. Thus, industrialization frequently caused more of the county population to become "urbanized" or "suburbanized" without causing any overall increase in county population.

Industrial location is often promoted as a technique for achieving urban-rural population balance. Our findings, however, suggest that what industry does achieve is a redistribution of the local rural population rather than a movement of people into the area from distant metropolitan areas.

In a number of case studies, the age composition of the population also showed slight change with the arrival of industry. The changes were primarily due to migration in one form or another. In some instances, age declined due to in-migration of young workers with young families.

A close look at twelve case studies revealed that most industries preferred to hire young adults who could handle physically hard work. Yet, surprisingly, industrial development failed to stem the flow of young people migrating out of rural communities. This is noteworthy in light of the popular notion that attracting more industry to the small town will eliminate the need for the young to leave home in search of work.

Benefits to the Public Sector

Industry is actively sought by small communities in the hopes of enlarging the community's tax base. An enlarged tax base means an increase in public income and the expansion of community services. In general, industry's contributions to the public income can be divided into two categories: direct payments and induced (or indirect) payments.

Direct Payments

Property Tax. The actual size of industry's property tax bill is largely determined by local and state tax structures and by negotiated agreements between local government officials, development representatives and industrial management. Case studies show that frequently local government is willing to grant "tax holidays" exempting industrial property from taxation for 5, 10, or 15 years. This is a form of subsidization for industrial development and as such is a *cost* to local government.

Fees and Service Charges. Communities with municipally owned utilities can expect direct payments from industry for services rendered. These utility fees should at least equal the cost of extending service to the plant. The evidence suggests that in many communities costs are, in fact, all that is recovered from fees and there are no net gains from utility payments.

The few studies which focused on industry's direct payments to local government suggest that most of the potential for income gain by the host community is bargained away. Many local leaders are willing to trade direct revenues from new industry for indirect funds on the apparent assumption that the latter will outweigh the former.

Indirect Payments

Indirect payments by industry to the public sector are more diverse and are based on industry's ability to boost local average income and subsequently increase the value—and tax assessments—of local properties and businesses.

Wages and salaries paid by the new industry are a stimulus to growth and add to local income only to the extent that the plant's payroll is spent in the host community. However, one case study revealed that through leakage of income to nonlocal recipients, an average weekly plant payroll of $6,000 shrunk to $4,779. The "leaked" money was spent primarily on food, services and investments in neighboring communities; was put into savings; and was used to pay off old debts. In rural communities, gains in aggregate disposable income may be more apparent than real for the local market.

Increases in local public revenues result from industrial development only when growth in the private sector is converted into public monies. These monies include increased property taxes from the expansion or construction of new homes and businesses, increased retail sales and sales tax,

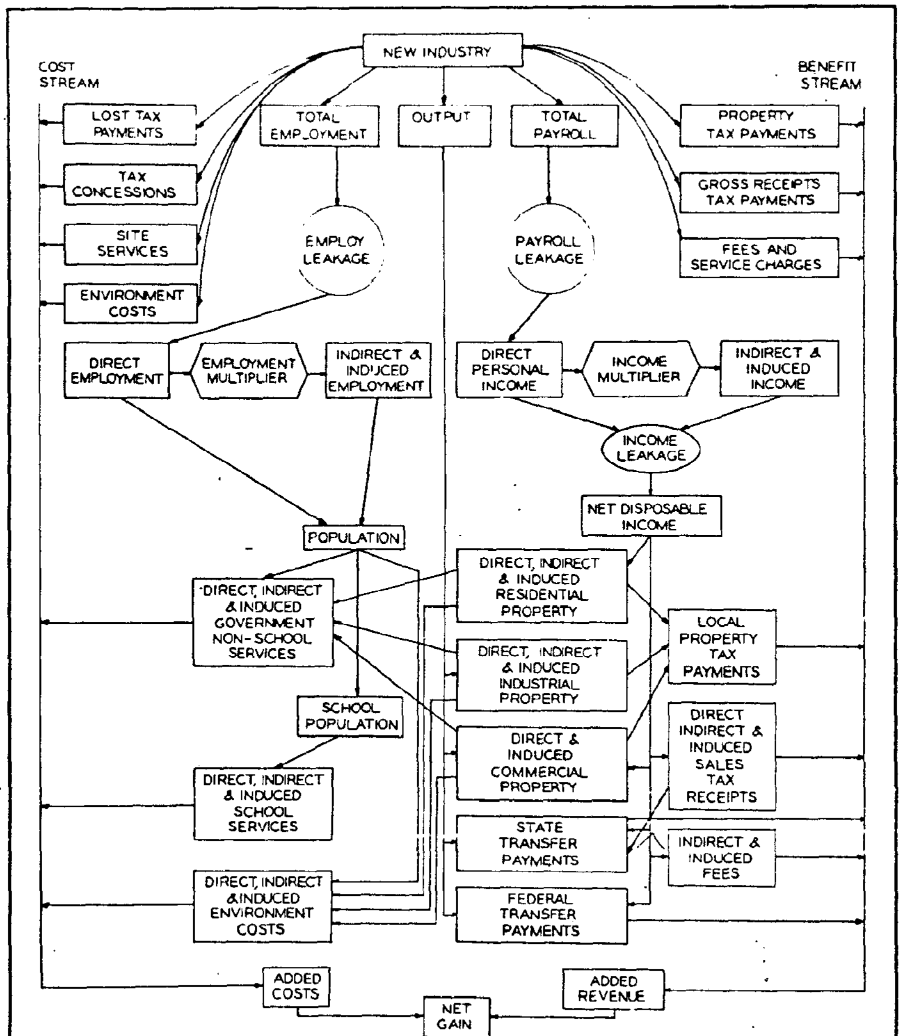


Figure 1: Flow chart for Public Sector Costs and Benefits of New Industry
(Adapted from Hirsch, 1961)

increased utility fees and an increase in the transfer of state and federal revenues to the local community.

Residential and Commercial Property Tax. New manufacturing jobs in a community generally mean that more income will flow into home construction and improvements. This in turn means an increase in property values and proportionately, property taxes. Likewise, as residents spend more disposable income and as industry draws upon the services of local businesses, existing commercial establishments will expand. In fact, all the case studies showed that industrial development did bring increases in assessed valuation of property and subsequent increases in local property tax revenues.

However, the case studies also revealed that increases in housing construction or business expansion cannot be predicted with certainty. Many small towns have both underutilized housing and excess business capacity. This slack means that the town can accommodate a certain amount of growth without ever increasing its commercial or residential tax base.

Retail Sales. Case studies showed that retail sales in industrially developing communities increased substantially from pre-industry levels. In those communities which have a local sales tax, or which receive a transfer of state sales tax receipts, this growth in sales can mean increased revenues.

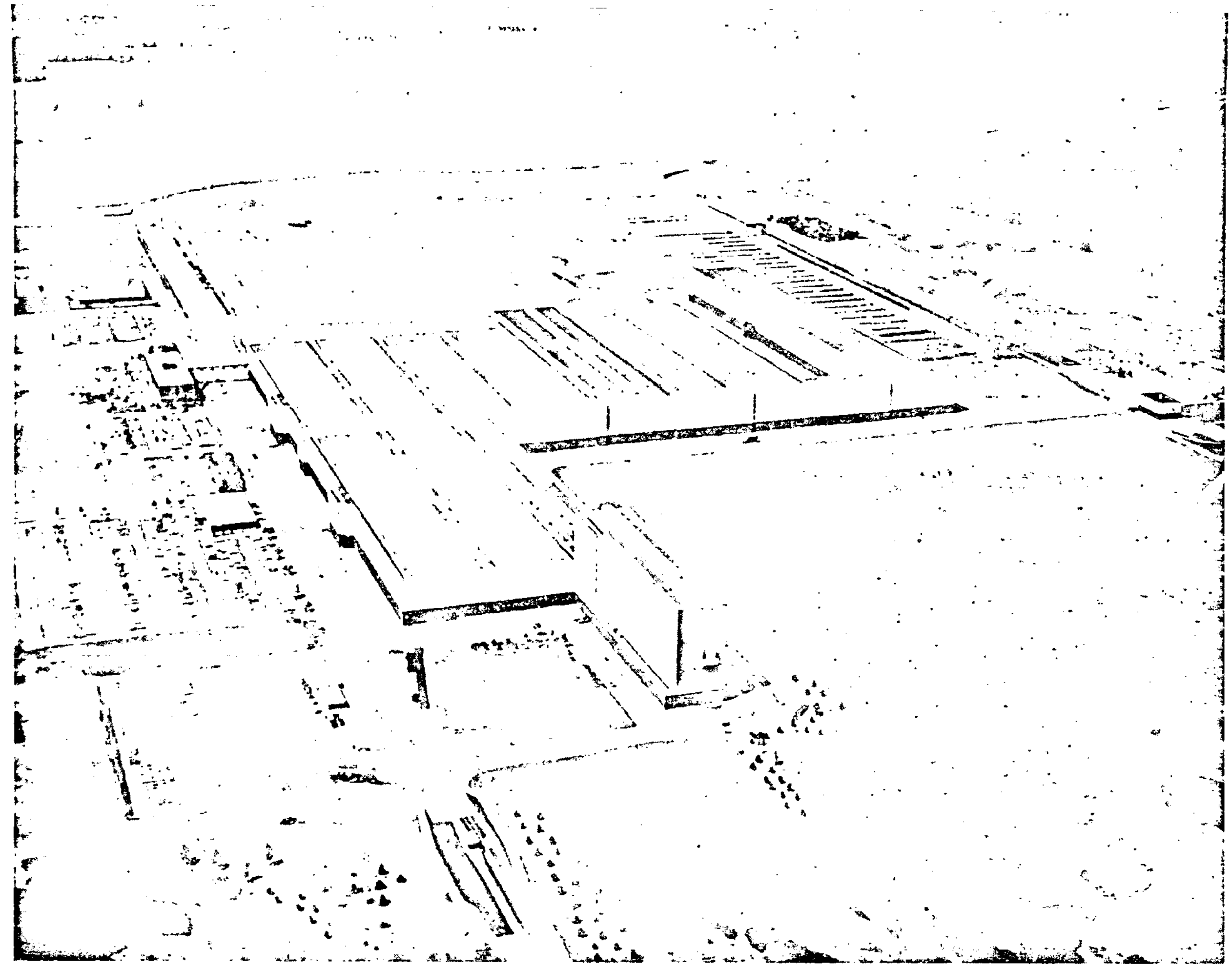
Fees for Services. User fees and charges such as licenses, building permits and rental fees on publicly owned land generally increased as a result of increases in disposable income or a change in the consumption pattern of residents.

Public utility income was seen to rise in a number of case studies.

Intergovernmental Transfer of Payments. Because of legislative constraints placed upon their taxing authority, many municipalities appeal to state and federal governments for a transfer of funds back to the local level. The case studies indicate that as industrial development increases the local average income and as industry's output grows, the volume of these transfer payments also increases. Larger amounts of the taxes on personal income (gasoline, sales, and income tax are typical) find their way back to the local community. Similarly, a greater proportion of corporate income taxes or gross receipt taxes on industrial output are turned back to the host community rather than being added to the state's general fund.

The case studies suggest, however, that industrialized communities may come to depend on state and federal payments for a larger share of their total receipts. Frequently, this dependence on transfer payments is only temporary and declines after a period of adjustment. For example, since the gasoline tax is more immediately responsive to growth in economic activity than is assessed valuation of property, local officials may temporarily rely on gasoline tax transfer payments rather than on property tax to meet immediate costs.

The case studies are very consistent in reporting increases in local revenue following industrial location. The assessed



valuation of property clearly is expanded and property tax receipts increased in every community. Retail sales consistently increased resulting in added revenue from sales tax. Intergovernmental transfer payments increased in absolute dollar amounts and communities appeared to shift the tax burden from local toward nonlocal revenue sources. The sum in the benefit column can add up to a substantial amount.

Cost to the Public Sector

If one considers only the benefit stream, the conclusion must be that new industry produces added revenue for the local public sector. But an often overlooked fact is that the added revenue brought to the community by industry may be equalled or even exceeded by added and often unexpected costs. For this reason it is extremely important to consider how new industry contributes to the costs of the public sector.

Attracting New Industry. The initial costs of new industry arise when a community attempts to attract a plant to its area. The most frequently incurred costs in the wooing of industry are as follows:

* land acquisition costs,
* site preparation (including extension and improvement of access roads and preliminary landscaping),
* loss of previously collectable property taxes in instances where new industry is given a tax "holiday" or reduced rate,
* increased police and fire protection,
* provision of water and sewerage, electricity and/or gas, often for fees that are less than cost.

As an example of the large investments that some communities have in their efforts to attract industry, consider the city in Kentucky that issued $250,000 worth of industrial revenue bonds to finance land acquisition and building construction for a shoe factory. Since the land and building were city-owned, they were exempt from real property tax. In addition, the city granted the company a five-year exemption from personal property taxes.

In another case, a Kentucky city issued a $650,000 revenue bond and held title to the land, building and part of the equipment of the plant making them nontaxable. The city also extended a water line to the plant at a cost of $10,000 to the city.

All these development efforts by the local community are forms of subsidy and must be regarded as costs to the community. In some instances, part of the subsidy cost is recovered, but in other instances only a partial recovery is achieved. Often local public officials underestimate a new industry's requirements for community services above and beyond the initial commitment to land, building and equipment. These additional costs of government services, plus costs of school expansion and environmental degradation, also must be recovered by the public sector if it is to realize a net gain from new industry.

Accommodating Growth. Besides the costs of attracting industry, the host community must also accommodate the costs of a growing population. As mentioned above, industry frequently brings an influx of new workers who are primarily young adults with families. These in-migrants place increased demands on the community for schools, health care, and recreational and general services.[1]

Growth in the number of residential and business properties also places greater demands on local government to provide improved police and fire protection, road maintenance and water and sewerage services. Eleven out of twelve case studies showed substantial increases in costs of community services to residents with the arrival of industry. Water and sewerage services, particularly, were important sources of increased cost. Rockdale, Texas, for example, was forced to drill a new city well and to issue a bond for sewerage line extension as a result of industrial development.

The case studies suggest that while public officials often overestimate their communities' growth capacities, they underestimate the capacity of existing utilities and services to accommodate development. The result is a major outlay of public funds that increase the per capita cost of public services.

Expanding School Services. The case studies provided consistent evidence that new industry increases the population of school-age children. It is also clear that increased enrollment resulted in increased operating budgets for schools and sometimes in high capital outlay to accommodate new students.

While some of these additional costs are recovered through increased taxes and intergovernmental transfer payments, part of the burden must be carried by the host community.

Left (page 10): Aerial photograph of the new Hennepin Works Division of Jones & Laughlin Steel Corporation, about 120 miles southwest of Chicago. The plant, which is now nearing full production, is located on J&L's 6,000 acre site, and has about 30 acres under roof.

Below: Jim Larison photo shows the effect of new sewage lines on rural land.

Environmental Degradation. Industry brings long-term alterations of the environment: loss of open space and agricultural land, increased man-land density and changes in land use patterns. In addition, industry frequently brings problems of air, noise and water pollution. At the time most of the case studies were made, the environment was not a major concern and one observer made this comment:

> The most striking social cost to the town imposed by industry is water pollution, which in most of the towns studied has reached serious proportions. The concern for this problem shown by town governments is after the fact. Since industry is primarily responsible, the weak position taken by local government suggests that the absence of water pollution control is one form of industrial incentive.[2]

Net Gains

The net gain of new industry to the local public sector is the difference between its direct and indirect cost and its direct and indirect benefits. While most case studies have stressed the benefits side of the ledger, a few have also looked at the cost side and found some interesting facts. In one study five Kentucky towns with eight new plants were examined. It was found that only two of the plants produced revenues in excess of that yielded by the property prior to the plant location. Analysis of secondary impacts, where one might expect net benefits due to operation of the multiplier effect, corroborated the negative impact of new industry.

Other studies which compared estimated net gains of the private sector with net gains by the public sector also showed some sharp contrasts. One estimate, which closely approximated actual conditions in twelve communities, showed the private sector averaging a net gain of $152,981. The public sector averaged only $521 and the school district $401. This kind of evidence challenges the belief that new industry will substantially improve the fiscal burden of many nonmetropolitan communities. The evidence also suggest that were local government more assertive in channeling private sector gains into the public sector, industrial location could contribute more positively to a community's fiscal well-being.

In summary, industrial location in the rural community can bring employment, population growth and economic prosperity to the area; but as the studies have shown, these benefits do not come automatically nor do they apply in all cases. In some instances the structure of the community and the character of the particular industry merge to the benefit of both parties. More often the industry clearly gains while having a negligible or even negative effect on the host community over the long run.

[1] Gene F. Summers, Sharon Evans, Jon Minkoff, Frank Clemente, and Elwood M. Beck, Jr., *Industrial Invasion of Nonmetropolitan America*, New York: Praeger Publishers, 1976.

[2] Abt Associates, Inc., "The Industrialization of Southern Rural Areas: A Study of Industry and Federal Assistance in Small Towns with Recommendations for Future Policy," Washington, D.C.: U.S. Dept. of Commerce, Economic Development Administration, Office of Economic Research, December, 1968.

TWO NORTH CAROLINA COMMUTING PATTERNS

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THIS study examines the commuting patterns of production workers at two industrial establishments in eastern North Carolina. Each of the two plants investigated is situated in the area of Kinston, a city of nearly 30,000 population, and together they account for well over half of the manufacturing employment in the county centered on that city.[1] One of the establishments, a producer of synthetic fiber,[2] employs approximately 2200 persons and is noted for its "above-average" wages; it employs workers who commute from points within a broad area extending out 40 miles and more. The other plant, a shirt factory,[3] employs about 900 persons, and is considered "below-average" in its wages; it draws much of its labor from the area in the immediate vicinity of the plant. The two industrial facilities thus provide a broad spectrum of wages and commuting distances and facilitate an examination of wages and other factors as variables affecting the pattern of commuting of industrial workers in the area. The study was conducted in the spring of 1964.

The specific objectives in this study are fourfold: (1) to analyze and compare the characteristics of the two commuting patterns and identify the respective labor market areas; (2) to observe the effect on commuting of such personal factors as wages, age, sex, and length of service; (3) to investigate the significance of two geographic variables—population and distance—by constructing a series of probability models based on gravity concepts; (4) to consider some other geographic variables which may explain discrepancies between the actual distribution of commuters and those suggested in the probability models. These probability models are not universally applicable, but they may nevertheless provide a tentative basis for estimating the potential availability of commuting labor in areas where conditions might be similar to those in eastern North Carolina.

Commuting studies have a proper and important place in geography. Commuting distance can be used as a basis for delimiting labor market areas or "labor-sheds"—the area supplying labor to some central point. The labor-shed is a regional conception—an extent of space functionally organized about some nodal point such as an individual

[1] Kinston is the commercial center and largest town in Lenoir County, which has a population approaching 60,000 and manufacturing plants employing about 5600 persons.

[2] E. I. du Pont de Nemours & Company, Kinston plant, established in 1953, is a major supplier of *Dacron*® polyester fiber.

[3] The Kinston Shirt Company, in operation since 1937, accounts for about 2 per cent of the United States output of men's dress and sport shirts.

factory, a group of plants, or a whole complex of economic activities embraced by a city. Commuting or "journey-to-work" patterns could form the basis for delimiting networks of overlapping regions across the whole expanse of a territory. Commuting studies offer geographers the opportunity to apply their skills in seeking answers to some important practical questions. For example, the extent of the labor force potentially available at some point is directly influenced by the territorial extent of the labor-shed, i.e., by the number of miles workers are willing to commute. This may be an important consideration when an industry seeking a new location with an assured labor supply must decide among several alternative places.

Commuting studies are particularly appropriate and pertinent in the case of North Carolina, a state striving to attract new industry in order to expand employment and raise presently low income levels. The traditional attraction for manufacturing concerns has been the large supply of labor willing to work for wages which, though "modest" by national standards,[4] are above those prevailing in many non-industrial occupations in North Carolina. Surveys conducted by the Employment Security Commission of North Carolina indicate that a large reservoir of employable labor remains to be tapped;[5] the supply is especially abundant in rural areas[6] where out-migration has proceeded more slowly than might be expected in view of the limited economic opportunities in many of these areas. Given an opportunity to work in a nearby industrial plant, rural and small-town dwellers have shown a marked propensity to maintain their established place of residence and a willingness to commute great distances to work.[7] Thus industries often draw their labor from remarkably broad geographic areas. As might be expected, the higher-wage industries are able to attract labor from much wider areas than are other industries; this point will be demonstrated later in this paper. An industry considering a location in North Carolina can compare the wages it is prepared to offer with those prevailing in a specified area, and with an understanding of commuting tendencies in this region, it can proceed to estimate the size of the labor force that might be marshalled at any particular point.

While this paper focuses on two individual cases in a single region, the study is intended to be of more than just local interest. Hopefully, it will be of use to other analysts undertaking similar studies by pointing out some of the problems encountered in conducting such journey-to-work surveys. In addition, the paper presents one method for analyzing a commuting pattern. Also, by adding to the number of studies of individual areas, the likelihood of developing a general theory on commuting is perhaps improved by some small degree. It can be reasoned that if an acceptable general theory on travel-to-work behavior is ever to be established,

[4] The average hourly wage in North Carolina manufacturing plants in October, 1964, was $1.69, the lowest for any state in the United States. The national average for manufacturing workers at this time was $2.47.

[5] For example, when the Proctor Electric Company established a new plant at Mt. Airy in 1957, they had 3500 applicants for 288 job openings, far in excess of the anticipated number of applicants; see "Staffing a New Plant in a Small Labor Market Area" (Employment Security Commission of N.C., Raleigh, 1960).

[6] The extensive reserves of labor in and around small towns has also been observed in the Middle West by Richard C. Wilcock and Irvin Sobel: "Small City Job Markets: The Labor Market Behavior of Firms and Workers" (Urbana, Ill., 1958).

[7] K. J. Walraven discusses this same point in his Arkansas study: "Impact of New Plants on Local Labor Supply: Northwest Arkansas" (Little Rock, Ark., 1962).

the key elements in the theory—e.g., the relationships between commuting distance and wages, length of service, etc.—will likely be discerned from a multitude of individual empirical studies.

THE STUDY AREA

Workers commuting to the two industrial plants examined in this paper are mostly drawn from a ten-county area[8] on the coastal plain of eastern North Carolina (Table I and Fig. 1). There are no major natural features such as mountains or large water bodies which seriously influence the general geographic pattern of commuting. Significant differences in the density of paved roads do exist, however; the availability of such roads decreases as one moves south and eastward (Table I). This reflects diminishing population densities toward the south and east where the land is decidedly less suitable for agriculture because of poorer soil and drainage conditions. About one-third of the study area's labor force is in agriculture (compared with 7 per cent nationally); tobacco is by far the most important crop, with peanuts, cotton, corn, and soybeans also significant.

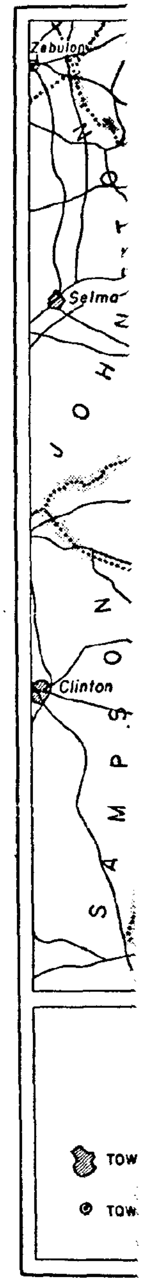
The population of the ten-county area was approximately one-half million in 1960, up about 8 per cent from 1950 (compared with a national gain of 19 per cent in the same period); four counties experienced population losses in this decade (Table I). The population density ranges from about 150 per square mile in the northwest to less than 50 in the south and east (Table I). Five towns (Goldsboro, Greenville, Kinston, New Bern, and Wilson) have populations over 10,000; overall the population is about 30 per cent urban, nearly average for North Carolina, but far below the national level. The Negro population is rather uniformly high, averaging about 40 per cent, and Negroes account for about a quarter of the manufacturing labor force.

Income levels are generally low. In 1962 the average per capita personal income in the study-area counties ranged from about $900 to $1500, averaging two-thirds the state mean and less than half the national level. Wages in manufacturing, which employs about 17 per cent of the area's labor force, are generally above those in most other branches of the economy, but still averaged scarcely $70 a week in 1963. The leading branches of manufacturing are food products, textiles, apparel, wood products, and chemicals. The majority of food, textile, and apparel workers earn between $1.25 and $1.50 an hour, while those at the large synthetic fiber plant near Kinston average over $2.50 an hour. Local chambers of commerce boast of the "lack of labor strife" and the prevailing absence of strong labor unions. But economic opportunities are limited, unemployment has been high, and many workers remain underemployed.

THE QUESTIONNAIRE

A travel-to-work questionnaire (Fig. 2) was given all production workers (wage earners) at the two industrial plants. Salaried personnel were omitted only because company officials preferred they be excluded. The questionnaires were distributed and collected by plant supervisors, and there was a return rate of about 90 per cent. Of the returned questionnaires about 10 per cent were screened out because of incomplete or obviously false answers. The final sample population consisted of 1052 workers at the synthetic fiber plant and 734

[8] Ten counties supply approximately 98.5 per cent of the commuters who identified their residential location on a questionnaire. Small numbers of commuters originate from four other counties (Edgecombe, Martin, Onslow, and Pamlico).



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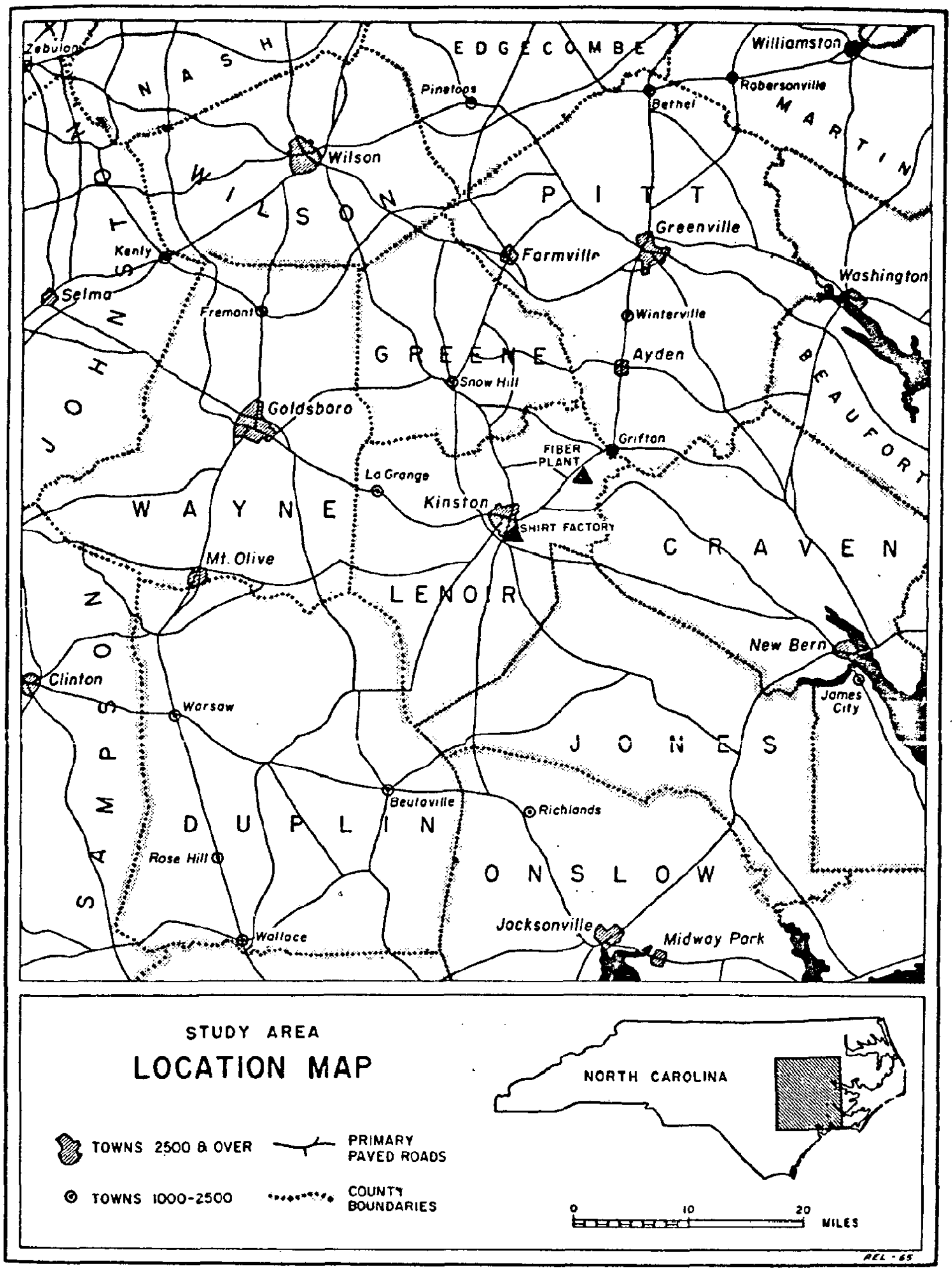


FIG. 1.

workers at the shirt factory, a total of 1786 wage earners. The questions asked of the workers are indicated in the sample questionnaire shown as Figure 2. Workers living a significant distance (over 3 miles) from the plant were also asked to locate their place of residence on a map included on the questionnaire.

TABLE I

SOME CHARACTERISTICS OF INDIVIDUAL COUNTIES IN THE STUDY AREA

	Population, 1960[a]					*Employment*				*Income*		*Per cent of labor force unemployed 1963*[d]	*Paved roads, 1963, mi. per sq. mi.*[e]
	Total	*Per cent change 1950–1960*	*Density per sq. mi.*	*Per cent urban*	*Per cent non-white*	*Total 1960*[a,f]	*Agricultural 1960*[a,f] *No.*	*Agricultural 1960*[a,f] *Per cent*	*Manufacturing 1963*[b,g]	*Per capita 1962*[c,f]	*Average weekly mfg. wages 1963*[b,g]		
CENTRAL COUNTIES													
Lenoir	55,276	+20	141	45	40	18,016	3,882	22	5,609	$1,495	$95.50	8.5	1.84
Pitt	69,942	+10	106	43	44	22,353	6,488	29	3,270	1,387	72.39	8.8	1.56
Greene	16,741	−7	62	0	50	4,531	2,831	63	132	1,288	52.27	8.4	1.70
NORTHWESTERN COUNTIES													
Wayne	82,059	+28	148	41	37	22,522	5,087	23	3,328	1,472	72.68	6.6	1.74
Wilson	57,716	+6	155	50	40	19,596	4,386	22	3,915	1,510	67.34	11.0	1.83
Johnston	62,936	−5	79	20	22	20,989	6,768	32	3,989	1,422	59.58	7.1	1.88
SOUTHERN COUNTIES													
Duplin	40,270	−2	49	0	38	13,259	5,893	44	2,085	1,193	64.40	4.0	1.74
Jones	11,005	0	24	0	47	3,186	1,467	46	144	902	49.15	6.0[h]	0.68
EASTERN COUNTIES													
Beaufort	36,014	−3	43	28	37	11,061	2,866	26	2,095	1,265	53.32	5.1	1.05
Craven	58,773	+20	81	27	29	14,999	2,333	16	2,031	1,541	68.61	6.6[h]	1.14

[a] *1960 Census of Population*, Vol. 1, Part 35.
[b] *North Carolina Insured Employment and Wage Payments, 1963*, Employment Security Commission of N.C., Raleigh, 1964, Table 5.
[c] from data compiled by Dept. of Tax Research, State of N.C., Raleigh, 1964.
[d] from data compiled by Employment Security Commission of N.C., Raleigh.
[e] from data compiled by Planning Dept., N.C. State Highway Commission.
[f] by place of residence.
[g] by place of employment.
[h] 1960 data.

[illegible] TWO SAMPLE POPULATIONS

[illegible] basic characteristics of the two [illegible]muter groups are indicated in Table [illegible] As is evident, the two populations [illegible] rather similar with regard to age and [illegible]th of employment (the fiber plant [illegible]ned only in 1953; the average length [illegible] service of fiber workers should in[illegible] with the passage of time), but [illegible]er greatly in average wages and the [illegible] between sexes. As would be [illegible]ected, the shirt factory relies heavily [illegible] female labor, most of whom receive [illegible] an hour. The shirt firm is located [illegible]thin the city of Kinston, enabling [illegible]r number of employees to walk to [illegible]. The fiber plant, on the other [illegible]nd, is situated in the country, seven [illegible] outside of Kinston, and essentially [illegible] employees commute by automobile.

THE MEASURE OF COMMUTING

There is some question as to what is [illegible] most satisfactory measure of com[illegible]ing. In the majority of studies a [illegible]aight mileage measurement is em[illegible]oyed. A few analysts have measured [illegible]muting distance in time (i.e., min[illegible]tes). The popularity of miles over [illegible]utes is understandable; mileage can [illegible] measured directly from an ordinary road map, whereas the determination of travel time requires either a field survey or an interview of workers actually doing the commuting. The use of time as a measure can be defended on the ground that a worker's willingness to commute presumably depends in part on the "effort" involved. Ten miles of "fast" open highway requires less effort than 10 miles of "slow" city streets or dirt roads, and in this instance the number of miles would likely be a poor measure of commuting distance. Along this line, one geographer has recently suggested that commuting be measured in terms of "travel effort," taking into consideration the number of stop signs, turns, congestion, etc.[9] But the obvious difficulty in obtaining such data for all the roads in the commuting area will likely preclude much use of this measure. Cost has been suggested as a possible measure of commuting. The assumption is that the expense involved may, beyond a certain limit, discourage commuting. However, in this study area and in most others, many workers join car pools, and for them the cost is relatively minor compared with the time involved. On the other hand, a worker driving alone 30 miles each way would, at the rate of eight cents a mile, incur a daily expense of almost five dollars.

In this study, information on commuting mileage and time was obtained from the questionnaires. The presumption was that one might provide a better measure of distance than the other. To test the relationship between the two, time and mileage distance values for a 10 per cent random sample of fiber workers were plotted against one another on a scatter diagram (Fig.

TABLE II

CHARACTERISTICS OF TWO COMMUTER GROUPS

	Fiber Plant	Shirt Factory
[illegible] wage earners	1,052	734
[illegible]	875	71
[illegible]en	177	663
[illegible]gth of employment	98 mos.	82 mos.
[illegible]	98 mos.	86 mos.
[illegible]en	97 mos.	81 mos.
[illegible]	32.1 yrs.	32.7 yrs.
[illegible]	32.3 yrs.	31.2 yrs.
[illegible]en	31.4 yrs.	32.9 yrs.
[illegible] weekly wage	$109.13	$51.75
[illegible]	111.77	60.00
[illegible]en	96.54	51.06
[illegible] conveyance		
[illegible]	1,051	608
[illegible]	1	1
[illegible]	0	122
[illegible]	0	3

[9] John D. Nystuen: A Measure of Effective Distance in Urban Travel, *Abstracts of Papers*, 20th International Geographical Congress, London, 1964.

TRAVEL-TO-WORK QUESTIONNAIRE

A University of North Carolina research group is anxious to find out how much time workers spend travelling to and from work. The results of this and other studies will contribute to an overall understanding of North Carolina's industrial labor force, and will assist in developing plans for continued industrial progress.

Your cooperation in answering the questions below will be greatly appreciated. After completion of this form, please deposit it in the box marked "Travel-to-Work Questionnaire", which will be placed in a convenient location in your plant. Thank you very much.

****

1. Name of company where you now work: ____________________.

    (a) How long have you worked for them? __________ years.

2. How many miles from the plant do you live? __________ miles.

3. How long does it take you to get to work? __________ minutes.

4. How do you get to work? ______________ (auto, bus, walk, etc.)

5. Have you moved closer to work since taking your present job? __________.

    (a) If so, how many miles from work did you live previously? ________miles.

6. Are you now considering moving closer to the plant? ______________.

7. Personal data:

    (a) age ______ (b) sex ______ (c) average weekly wage, before taxes: $________.

8. If you live more than three miles from where you work, place an "X" mark on the map below, showing approximately where you live:

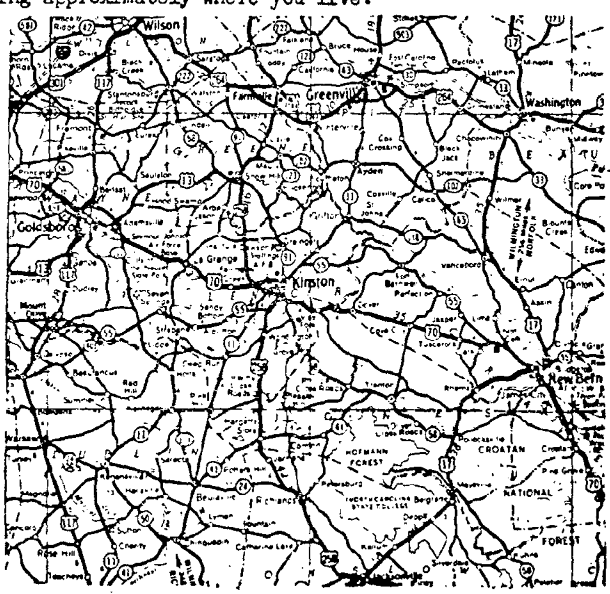
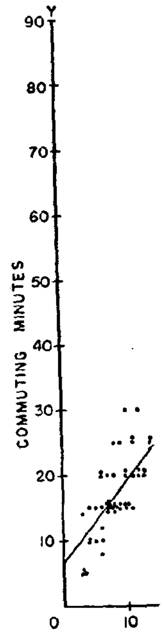


FIG. 2.



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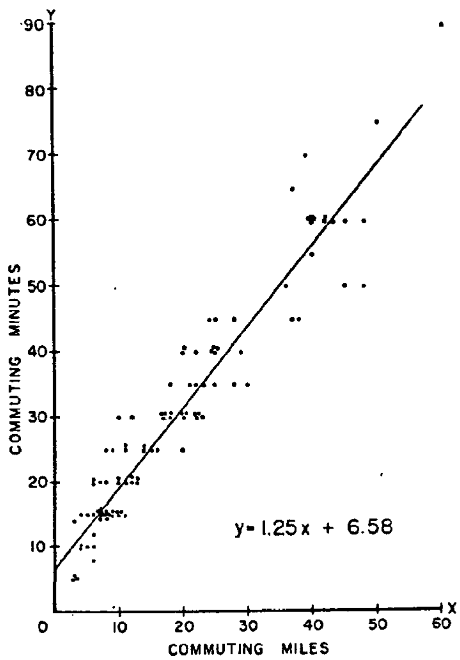
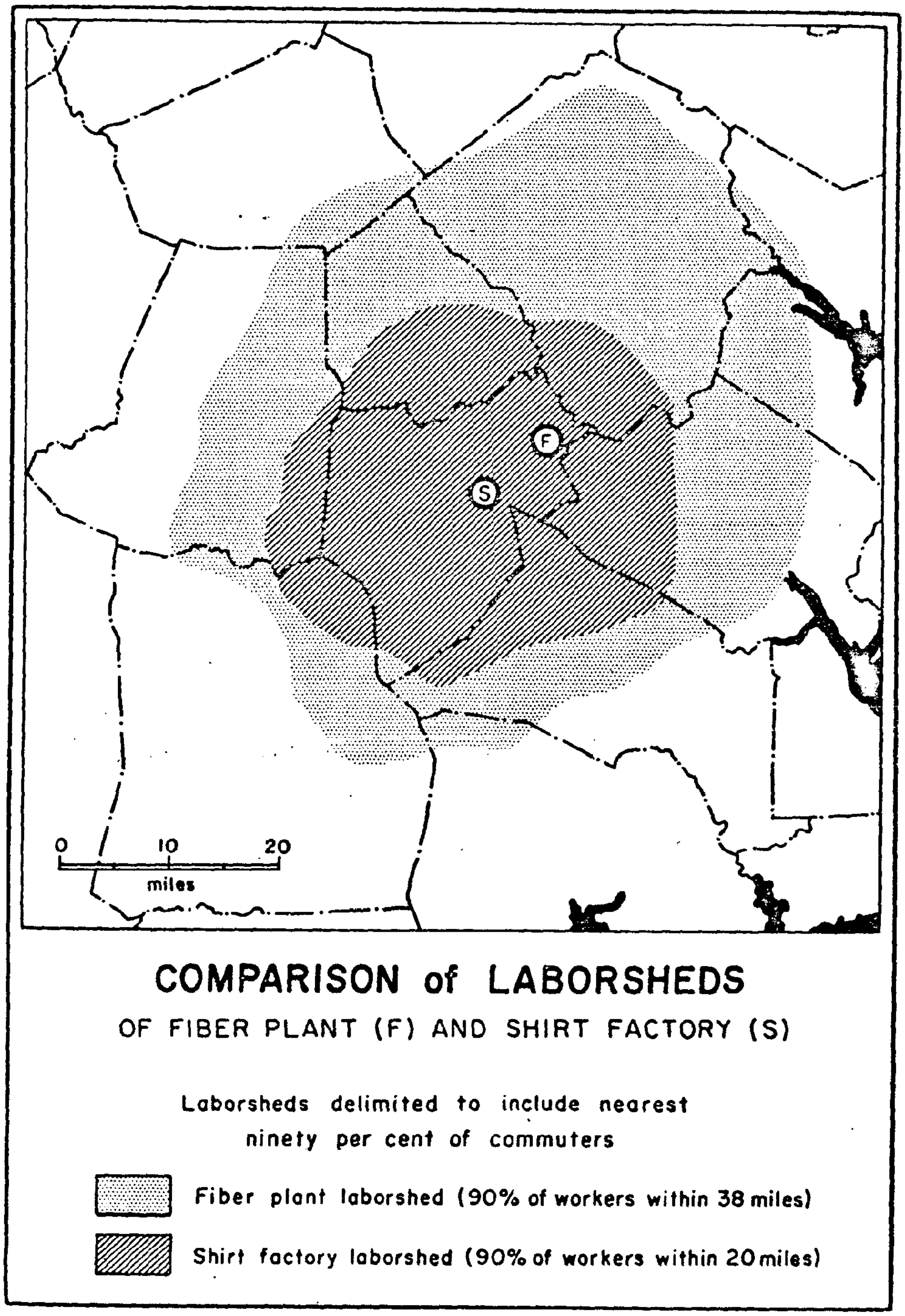


FIG. 3. Scatter diagram and regression line showing relationship between commuting mileage and commuting minutes, based on a 10 per cent sample of fiber plant workers.

3). As would be expected, a positive trend was clearly evident. The coefficient of correlation between the two is a very high +.96, suggesting that one is about as satisfactory a measure as the other. A regression line was established, with the "X" axis representing miles, and the "Y" axis minutes. The regression equation is $Y = 1.25x + 6.58$, which indicates that for fiber workers the commuting time increases 1.25 minutes per additional mile, and to commute "zero" miles requires approximately 6.6 minutes. The latter is presumably a measure of "terminal time," i.e., the time consumed in starting the car, getting out of the driveway, walking from parking lot to plant gate, etc. The possible superiority of one measure over the other is perhaps indicated by the degree of association between actual distributions of commuters and those distributions suggested by probability models based on gravity-model concepts. Twelve such models were constructed, using both miles and minutes as measures of distance; they are discussed later in this paper. A closer fit was obtained using mileage as a distance measure, but at best this is highly inconclusive evidence. In the probability models the frictional value attached to distance can be adjusted *ad infinitum*. It is indeed likely, therefore, that fits better than those achieved in this study could be obtained. In this study mileage is used more extensively than travel time only because it facilitates comparisons with other commuting studies, most of which used mileage exclusively.

CHARACTERISTICS OF THE TWO COMMUTING PATTERNS

The higher-wage fiber plant workers commute considerably farther than do shirt factory workers. The spatial extent of the two labor-sheds, in this case arbitrarily defined as the region encompassing the nearest 90 per cent of an individual plant's labor force, is shown in Figure 4. The fiber plant labor market area extends out almost twice as far from the point of employment and embraces an area about three times larger than the labor-shed for the shirt factory. Fiber plant workers travel an average of 17.5 miles each way and require an average of 28.7 minutes to cover this distance; median figures are approximately 13 miles and 27 minutes. By contrast, shirt factory workers travel an average of 6.7 miles one-way and require an average of 18.2 minutes; the median values are about 4 miles and 17 minutes. The distribution of commuters by five-mile and ten-minute zones for each of the plants is given in Tables III and IV. As can be seen by the figures in the cumulative percentage



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miles
COMPARISON of LABORSHEDS
OF FIBER PLANT (F) AND SHIRT FACTORY (S)
Laborsheds delimited to include nearest ninety per cent of commuters
Fiber plant laborshed (90% of workers within 38 miles)
Shirt factory laborshed (90% of workers within 20 miles)

FIG. 4.

TABLE III

DISTRIBUTION OF COMMUTERS BY MILEAGE ZONES

Zone	Miles	Fiber plant workers			Shirt factory workers		
		Number	Per cent of total	Cumulative per cent	Number	Per cent of total	Cumulative per cent
1	0–4	113	10.7	10.7	435	59.3	59.3
2	5–9	258	24.5	35.2	71	9.7	69.0
3	10–14	201	19.1	54.3	81	11.0	80.0
4	15–19	82	7.8	62.1	72	9.8	89.8
5	20–24	117	11.1	73.2	40	5.5	95.3
6	25–29	61	5.8	79.0	25	3.4	98.7
7	30–34	55	5.2	84.2	8	1.1	99.8
8	35–39	78	7.4	91.6	1	0.1	99.9
9	40–44	54	5.1	96.7	1	0.1	100.0
10	45 & over	33	3.1	99.8	0	.....	.....
Total		1,052	99.8	....	734	100.0	.....

columns of these tables, 80 per cent of the shirt workers live within 14 miles of their place of work, whereas just over half of the fiber workers live a similar distance from their plant. Over 15 per cent of the fiber workers travel 35 miles or more, while virtually none of the shirt workers commutes that far. The striking difference between the commuting habits of the two groups is not surprising in view of the better than two-to-one wage differential in favor of fiber workers, and the in-city location of the shirt factory as opposed to the more rural site of the fiber plant some seven miles outside Kinston.

The commuting distance of fiber workers appears to be above the state average, and that for shirt workers somewhat less than average. In unpublished surveys conducted by the North Carolina Employment Security Commission, 77 per cent of the North Carolinians they interviewed live within 15 miles of their place of work, and 93 per cent within 24 miles. By comparison, within 15 miles of work are 80 per cent of the shirt workers but only 54 per cent of the fiber workers. It is worth noting that in average weekly wages in 1964 the fiber plant ($109) is also much above the state mean, and the shirt factory ($52) again below average.

A federal government survey of 6000 households in 357 geographic areas of the United States, conducted in October, 1963, provides a kind of "national norm" with which the two commuting patterns in this study can be compared.[10] According to this survey, 45 per cent of American workers commute up to four miles, and 76 per cent up to 10 miles. For these distances the fiber plant percentages are 11 and 40, indicating that its commuting distances are considerably above the national mean. The shirt factory percentages are 59 and 71, or much closer to the national average. The meaningfulness of such comparisons can be seriously questioned, as the national figures reflect largely urban conditions dissimilar to those prevailing in eastern North Carolina.

It is difficult to compare the commuting patterns in this study with those in previous studies of other areas in the United States. Comparisons of this sort suffer because of great differences in such circumstances as degree of urbanization, city size, terrain, availability of paved roads, mode of transportation, job opportunities, wage levels, etc. With these limitations in mind, a few com-

[10] *Home-to-Work Travel*, advance report, 1963 Census of Transportation, Bureau of Census, Washington, 1965, p. 6.

TABLE IV

DISTRIBUTION OF COMMUTERS BY TIME ZONES

Zone	Minutes	Fiber plant workers			Shirt factory workers		
		Number	*Per cent of total*	*Cumulative per cent*	*Number*	*Per cent of total*	*Cumulative per cent*
1	Under 10	36	3.4	3.4	131	17.9	17.9
2	10–19	288	27.4	30.8	308	42.0	59.9
3	20–29	258	24.5	55.3	130	17.7	77.6
4	30–39	173	16.4	71.7	97	13.2	90.8
5	40–49	164	15.6	87.3	59	8.0	98.8
6	50–59	57	5.4	92.7	5	0.7	99.5
7	60 & over	76	7.2	99.9	4	0.5	100.0
Totals		1,052	99.9	....	734	100.0	.....

parisons may be attempted. In a 1959 study of over 2000 workers at the Maytag Company plant in Newton, Iowa (population 15,000), the median distance was about seven or eight miles,[11] much below that for the fiber plant workers. Although each laborshed embraces a largely rural area, the farm wages are lower and the alternate job opportunities are more limited in North Carolina; perhaps this partially explains greater commuting distances in North Carolina.

The commuting habits of Kaiser Aluminum workers at the new Ravenswood, West Virginia (pop. 1175 at time of plant establishment in 1956), plant were analyzed in a 1957 investigation. This was a "depressed" and largely rural area where agricultural incomes were low and "well-paying" industrial jobs were as highly sought after as those with the fiber plant in this study. One year after the plant's opening, aluminum workers traveled a median one-way distance of about 20 miles,[12] or about half again as far as fiber plant workers. But many of the aluminum employees subsequently moved closer to the plant. In comparing fiber plant commuting with that observed in the Kaiser study, it is appropriate to consider the commuting distances of fiber plant workers when they first obtained employment. Questionnaire data indicate that 260, or nearly one-fourth, of the fiber plant workers have moved closer to the plant since commencing their employment; they originally commuted an average of 28.8 miles one-way, compared with the present 8.4 mile average. This would seem to indicate that the median distance of fiber plant workers when first hired was comparable to that of the West Virginia aluminum workers shortly after their hire by Kaiser. Both plants, in similar "low-income" environments, initially attracted commuters from exceptionally wide areas.

A 1948 survey of commuting at a spinning mill on the South Carolina piedmont showed a median one-way distance of six miles,[13] only slightly greater than that for the shirt factory. While the South Carolina plant is in a more rural setting, the rather similarly-low median commuting ranges probably stems from the fact that both

[11] C. A. Peterson: An Iowa Commuting Pattern and Labor Market Areas in General (Bureau of Labor and Management, State University of Iowa, Iowa City, 1961), p. 1.

[12] *Labor Supply and Mobility in a Newly Industrialized Area* (Bulletin 1261, U.S. Dept. Labor, Bureau of Labor Statistics, Washington, 1960), p. 21.

[13] J. M. Steep and J. S. Plaxico: The Labor Supply of a Rural Industry (South Carolina Agr. Experiment Station, Bulletin 376, Columbia, 1948), p. 21.

are in the "low-wage" category. Thus, despite limited job opportunities and low farm wages, neither plant attracted any large number of persons living a sizeable distance from the plant.

Delimiting the Labor-Sheds

In the majority of commuting studies few attempts have been made to delimit accurately labor-sheds or labor market areas. Where they have been delimited, their boundaries usually appear as perfectly concentric circles, or they are drawn to coincide with existing political boundaries. To the geographer, a proper delimitation would seem to be a necessary step if the labor-shed is to be conceived as a region. But immediately evident are several obstacles to such a regionalization. Labor-sheds overlap, particularly in those zones intermediate between two plants or "nodes" which are attracting labor. It may often happen, as it does in this study (Fig. 4), that one labor-shed may lie entirely within another, larger labor-shed. They cannot be conceived as mutually exclusive entities. On the other hand, the labor-shed can be thought of as a distinct region, but always as one whose limits: (1) diminish by degree rather than abruptly and (2) commonly overlap or encompass those of other labor-sheds.

The outlines of such a "diminishing" region can be shown on maps by the use of isolines. Around each factory or other nodal point attracting workers will be a series of commuting isolines ("isocoms"). These isolines can represent commuting mileage or time intervals (e.g., an isoline for every additional five miles of commuting distance). Each isoline can be translated into a line indicating the cumulative percentage of commuters contained within that line (e.g., the 25-mile isoline may encompass 75 per cent of the commuters, and be labeled either way). There is an absolute outer limit for any existing labor-shed, the isoline which includes 100 per cent of the commuters, However, a mere handful of persons commuting unusual distances can cause this outer limit to lie far beyond what might be termed the "effective limit" of the labor-shed. This raises the question of what constitutes such an "effective limit" in terms of the percentage of commuters included. There is no established norm, and any decision is presumably subjective. A reasonable limit might be the isoline embracing the nearest 90 per cent of the workers (Fig. 4).

Commuting isoline maps were prepared for the fiber plant and shirt factory labor-sheds (Figs. 5, 6, and 7). The data for constructing the maps were obtained from the questionnaires which, in addition to asking each worker his one-way commuting mileage and time, also requested each person commuting over 3 miles to locate his home on a map included in the questionnaire (Fig. 2). About 87 per cent of the fiber plant workers and 98 per cent of those at the shirt factory who returned questionnaires fully complied with this request. With this information it was possible to plot the approximate place of residence of 926 fiber plant and 719 shirt factory workers. Next to each place of residence on the map were recorded the mileage and minutes indicated on the questionnaire. This provided the control necessary to construct the commuting isolines. Intervals of five miles and ten minutes were chosen arbitrarily. The isolines are identified not only in terms of the miles or minutes from the plant, but also in terms of the percentage of all commuters contained within each isoline. Another approach, not employed here, would be to select those distance isolines which would indicate the percentage of commuters enclosed at regular intervals (e.g., 30 per cent, 40 per cent, etc.).

The commuting mileage isoline maps for the two plants (Figs. 5 and 6) both show the influence of the existing road network orientation. Isolines extend farthest out along major radial roads in typical "spiderweb" fashion. The fiber plant isolines appear rather elliptical in shape with a northeast-southwest orientation. This apparently reflects the position of the fiber plant on a main northeast-southwest road and the absence of a major east-west road in the immediate vicinity of the plant. The shirt factory isolines are more nearly circular because of the many roads radiating out from Kinston in all directions. In neither case are there any major distortions in the shapes of isolines because of the lack of through roads in any area. The shirt factory labor-shed is contained entirely within the fiber plant labor-shed, an observation noted earlier in connection with Figure 4. The fiber plant labor-shed was extended to the 45-mile isoline, which encloses 97 per cent of the commuters. For the shirt factory, it was only necessary to extend the labor-shed to the 30-mile isoline to embrace 99 per cent of the workers.

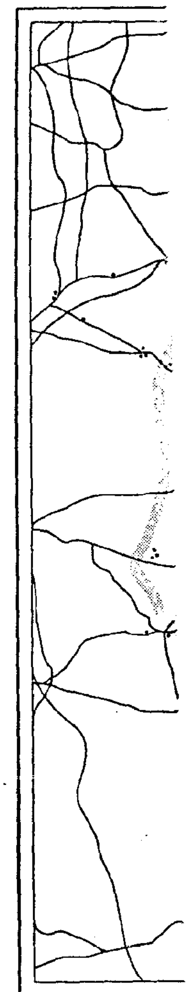
A commuting time isoline map was prepared for the fiber plant labor-shed (Fig. 7) for the purpose of comparing time isolines with those based on mileage. The commuting time isolines appear more irregular than do the mileage ones. They extend farther out along main roads, indicative of the higher speeds possible on major arteries. Nevertheless, the 60-minute isoline very roughly corresponds with the 45-mile isoline, which is consistent with the regression analysis. There does not appear to be any clear-cut advantage in using isolines based on time rather than on miles; the added difficulty of obtaining data on commuting time in itself seems to recommend the use of isolines based on mileage.

The delimitation of labor-sheds in terms of commuting isolines can be objected to on the grounds that the isolines do not necessarily identify the areas of densest commuter origins. For example, Figures 4 and 6 tend to give different impressions of the distribution of shirt factory commuters. As is clear in Figure 6, a much larger number of shirt workers originates from the lower-income areas south of Kinston than from the north; the labor-shed shown in Figure 4, delimited to include the nearest 90 per cent of commuters, includes areas north of Kinston, where few workers reside, and excludes districts south of Kinston (e.g., around Beulaville), where significant numbers of them live. A case can be made for rather arbitrarily positioning the outer limit of the labor-shed so as to include all areas of denser commuter origins and then drawing in just those isolines wholly or in part within the labor-shed.

WAGES AS A FACTOR INFLUENCING COMMUTING

A comparison of the fiber plant and shirt factory labor-sheds clearly suggests that "higher wage" workers are more willing to travel farther and therefore give up more of their "free" time. Presumably, everyone attaches some value to his time[14] and is reasonably aware of the full cost of driving and maintaining an automobile. Thus, one could assume that a more highly-paid worker is in a better position to bear the additional expenditures of

[14] For a discussion of this matter, see L. K. Loewenstein: The Spatial Distribution of Residences and Work Places in Urban Areas (Dept. of City Planning, Univ. of Pennsylvania, Philadelphia, 1962), pp. 4i-j (mimeo.).



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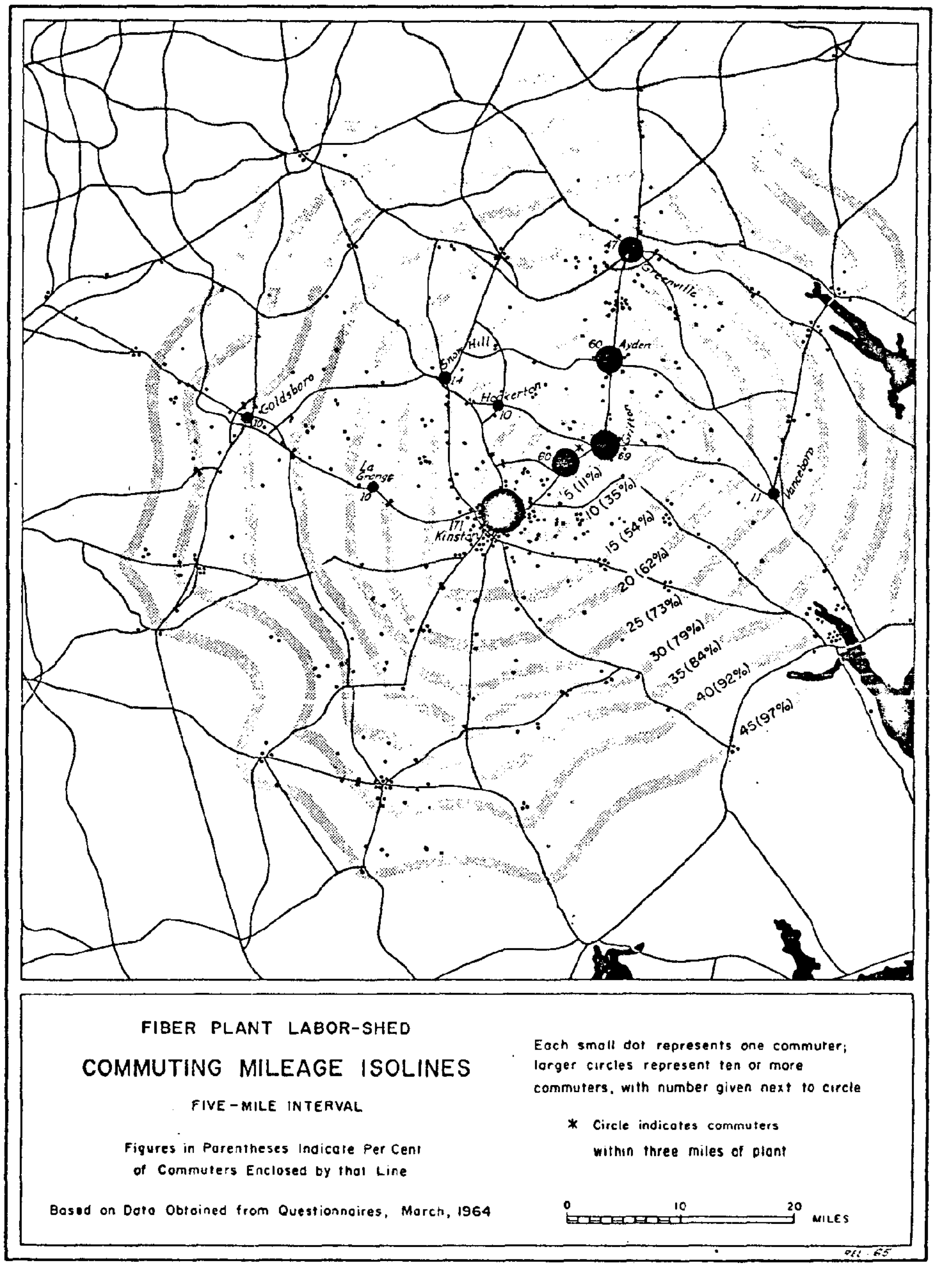


Fig. 5.

time and money. Yet among those who have studied commuting there are decided differences of opinion as to the relationship between wages and the journey-to-work.[15] Some analysts suggest that there is no relationship be-

[15] These differences were noted by James H. Thompson: Labor Market Areas for Manufacturing Plants in West Virginia (Bureau of Business Research, West Virginia Univ., Morgantown, 1955), p. 23.

tween the two factors, and one analyst, C. A. Peterson, in a study of commuting in Iowa, found data which suggested that there was an inverse relationship between the two factors; i.e., more-distant commuters received, on the average, a lower wage than those living closer to the plant.[16]

An examination of the fiber plant data alone indicates the lack of a direct link between wages and commuting distance. A scatter diagram with wages plotted against distance, drawn from a random sample of 100 fiber plant questionnaires, showed no discernible trend. The fiber plant data were then arranged to show the average wage of workers in each commuting zone (Table V). To make certain that a possible relationship was not obscured by differences based on the sex of workers, the data were also arranged by sex. The only conclusion that can be drawn from this table is that there is no correlation whatsoever between wages and distance within the fiber plant group. Another factor—the length of service of workers—was examined on the theory that it might be responsible for obscuring the link between wages and distance. A slightly higher percentage of long-distance commuters are younger, newly-hired workers (Table VI), and their average wage is below that for the group as a whole. However, a sample inspection indicated that even with this latter factor considered, there is still an apparent lack of connection between wages and distance within the fiber plant group.

It would be a mistake, however, to conclude from the above that wages and commuting distance are completely unrelated variables. It is true that within the fiber plant group there is no evident connection, but one has only to examine the commuting habits of the shirt factory workers for evidence that lower-paid workers in the same region do not commute nearly as far (Tables III and IV). The fact that a much higher percentage of shirt factory workers are female than male is apparently not a factor here; as shown in Table VI, there are no significant differences between male and female commuting in this area. Perhaps the critical element is whether wages are above or below those prevailing in the region being examined. The overall nonagricultural wage in the ten-county study area in 1964 was about $65 per

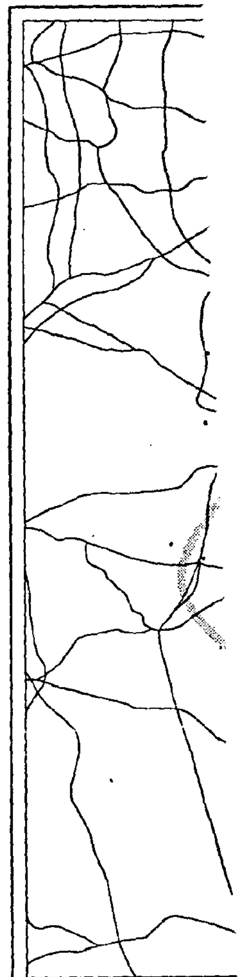
[16] Peterson, *op. cit.*, pp. 8–9.

TABLE V

AVERAGE WEEKLY WAGE OF FIBER PLANT WORKERS* BY COMMUTING ZONES AND BY SEX

Zone	*Miles*	*All commuters*		*Male commuters*		*Female commuters*	
		No.	*Wages*	*No.*	*Wages*	*No.*	*Wages*
1..........	0–4	105	$112.89	89	$115.91	16	$96.06
2..........	5–9	245	107.60	195	110.68	50	95.60
3..........	10–14	198	110.75	172	112.72	26	97.69
4..........	15–19	81	106.20	70	108.07	11	94.27
5..........	20–24	112	108.96	96	111.09	16	96.19
6..........	25–29	56	109.34	47	113.11	9	89.67
7..........	30–34	51	104.71	36	107.44	15	98.13
8..........	35–39	76	110.86	59	114.97	17	96.59
9..........	40–44	52	107.87	43	111.35	9	91.22
10..........	45 & over	32	110.25	29	111.69	3	96.33

*The size of this population (1008) is somewhat smaller than in some other tables due to the necessity for eliminating a few questionnaires where the desired combination of data required for this table were not wholly provided.



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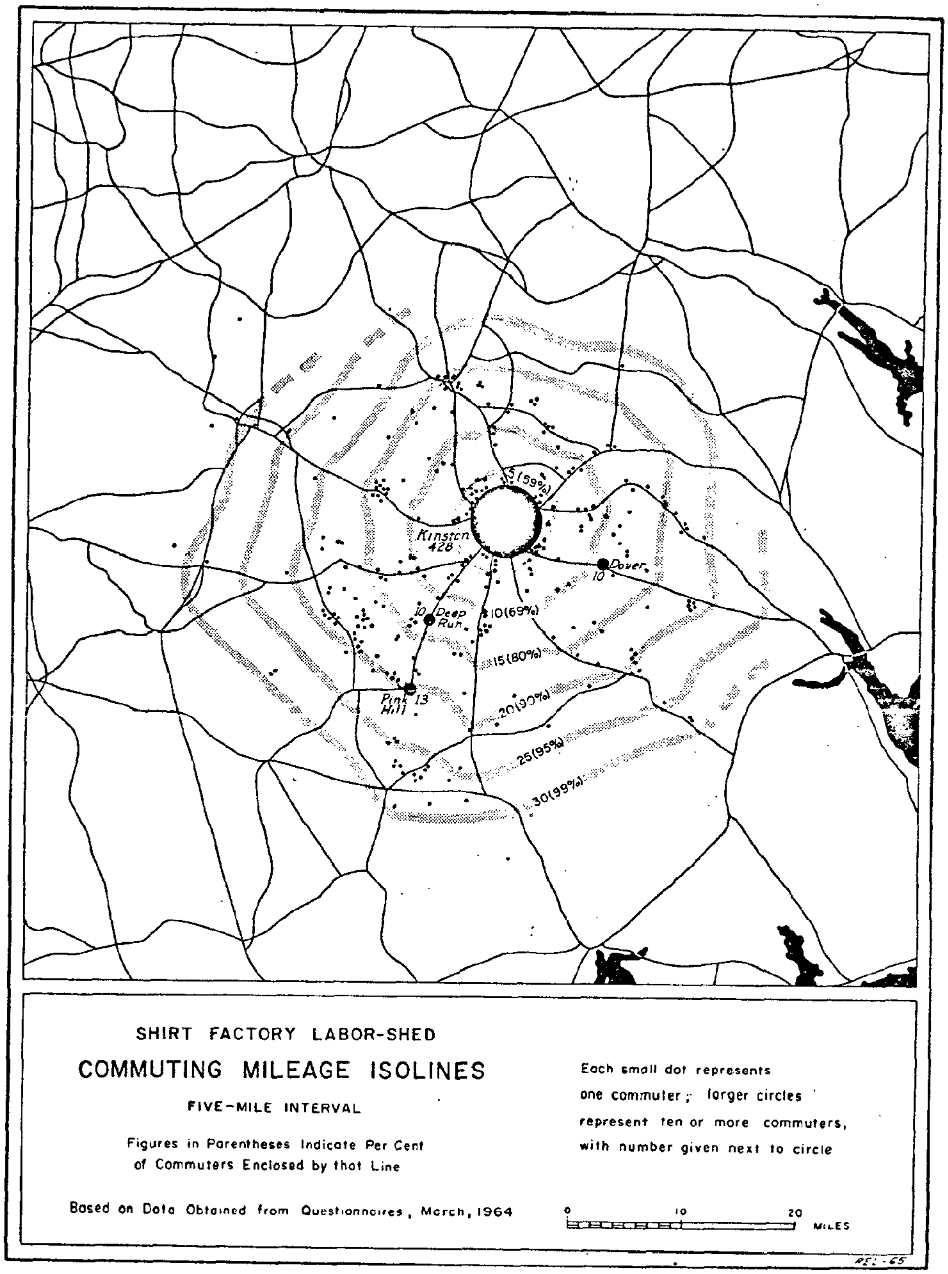

FIG. 6.

week, compared with $109 at the fiber plant and $52 at the shirt factory. Possibly, differences in commuting habits failed to show up within the fiber plant sample because virtually all fiber workers receive a wage above the ten-county average. The same was true of the shirt factory where the great majority of workers are paid a wage below the regional average. This suggests that there is a positive relationship between wages and commuting, and that when a plant offers wages appreciably above those prevailing in a region, one can expect, *cetera paribus*, workers to exhibit a greater willingness to commute long distances. This is consistent with findings in the study of Kaiser aluminum workers at Ravenswood, West Virginia.[17]

OTHER PERSONAL FACTORS INFLUENCING COMMUTING

Personal factors, those that vary with the individual worker, which may influence and thus help to explain a commuting pattern include, in addition to wages, the age, sex, and length of service of workers. Data on the latter three factors are shown by commuting zone in Table VI. The average age of workers declines somewhat with increased commuting distance; workers living close to the plant tend to average four years older than those doing considerable commuting. This is about equally true for both plants. Similarly, the average length of service for both groups diminishes with increased commuting distance, particularly in the case of the shirt factory. These findings are consistent with those of most other analysts who have noted a greater willingness (or necessity) of younger persons to commute and a lower seniority level of the average longer-distance commuter. These two observed facts are probably related: a younger person takes a job, commutes a considerable distance, and after several years when he commands a higher wage, decides to buy a house closer to the plant. Testifying to this is the fact that about one-fourth of the present fiber plant workers and one-sixth of those at the shirt factory have moved closer to the plant since taking their present job. Sex does not seem to be a factor in explaining commuting; for both plants the commuting habits of women are about the same as for those of the men. As Peterson noted in his Iowa study, "the lack of any consistent relationship between sex and commuting behavior is the only safe generalization that can be made."[18]

CONSTRUCTION OF PROBABILITY MODELS

A means of investigating the significance of two geographic variables—population and distance—is provided by constructing gravity probability models. The gravity concept holds that the potential interaction between two points or areas is directly proportional to their populations and inversely proportional to the distance between them. In the case of commuting, the gravity idea can be conceived as suggesting that an individual plant (or group of plants) attracts commuters from surrounding areas in direct proportion to the population of the area and in inverse proportion to the distance between the area and the plant. As is evident in Figures 5, 6 and 7, the density of commuter origins is not constant; nor does it diminish at a constant rate with increased distance from the plant. It is here assumed that much of this "unevenness" can be attributed to differences in distance and the spatial arrangement of population. Employing the gravity idea, a series of probability models was constructed, experimenting with various exponents of distance (measured in miles and minutes) in an attempt to establish a model which most closely approximated the actual distribution of commuters. It is reasoned that such a model provides a basis for judging the influence of population and distance

[17] *Labor Supply and Mobility*, *op. cit.*, pp. 28–30.

[18] Peterson, *op. cit.*, p. 11.

A

Zone	Miles	F p
1.....	0–4	3
2.....	5–9	3
3.....	10–14	3
4.....	15–19	2
5.....	20–24	3
6.....	25–29	3
7.....	30–34	3
8.....	35–39	3
9.....	40–44	3
10.....	45 & over	3(
All Zones..........		3

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[19] A similar approa Taaffe, and others: to Work, A Geograp ton, Ill., 1963), pp. 36

TABLE VI

AGE, SEX, AND LENGTH OF SERVICE OF WORKERS, BY COMMUTING ZONES

Zone	Miles	*Average age*		*Sex, fiber plant*			*Sex, shirt factory*			*Average length of service (months)*	
		Fiber plant	*Shirt factory*	*Male*	*Female*	*Per cent female*	*Male*	*Female*	*Per cent female*	*Fiber plant*	*Shirt factory*
1.....	0–4	34.2	33.9	96	17	15.0	44	391	89.9	110	95
2.....	5–9	33.1	32.9	205	53	20.5	8	63	88.7	106	89
3.....	10–14	32.5	30.8	174	27	13.8	4	77	95.1	98	63
4.....	15–19	29.8	30.8	71	11	13.4	7	65	90.3	74	53
5.....	20–24	31.6	29.0	101	16	13.7	4	36	90.0	97	31
6.....	25–29	31.6	28.4	52	9	14.8	3	22	88.0	92	44
7.....	30–34	30.5	29.1	40	15	27.3	1	7	87.5	89	79
8.....	35–39	30.0	22.0	61	17	21.8	..	1	100.0	95	48
9.....	40–44	30.4	28.0	45	9	16.7	..	1	100.0	89	144
10.....	45 & over	30.0	....	30	3	9.1	..	...	.....	90	...
All Zones..........		32.0	32.7	875	177	16.8	71	663	90.3	98	82

on commuting.[19] Such models also suggest a means for estimating the potential extent of a labor-shed about a proposed new industrial facility.

Probability models are presented for the fiber plant only. The fiber plant commuting pattern, involving greater distances and a much larger area, provides a more satisfactory basis for appraising the significance of population and distance as factors influencing commuting than does the geographically more-restricted shirt factory commuting pattern.

Before constructing the models it was necessary to make several decisions on methods and procedure. First, in all models a direct positive relationship was postulated between the number of commuters from an area and that area's population; distinctions between models are confined to varying expressions of the effect of distance on commuting. Second, the existing network of townships was used as the basis for regionalizing the ten-county area because of the availability of population data for each township. Third, the 1960 population data, available on a township basis, were used despite a four-year time difference; estimates of 1964 county populations fail to show any significantly large shifts in population within the study area since 1960. Fourth, the area under consideration was limited to those 74 townships shown to be wholly or largely within a one-hour commuting distance of the fiber plant (Fig. 7). One-hour's distance was selected because it includes almost all commuters and appears to represent a distance beyond which few workers would consider commuting. As noted earlier, the one-hour isoline corresponds rather closely with the 45-mile isoline on Figure 5. Fifth, the approximate population center-of-gravity of each township was used to measure the distance between a township and the plant; distances were read off the commuting isoline maps, in miles or minutes (Figs. 5 and 7). Sixth, in indicating the distribution of commuters suggested by a model, each of the 74 townships is placed in an appropriate distance zone for purposes of simplicity and the data presented by such zones; zones were established over intervals of five miles and six minutes, respectively. Six minutes was chosen as the time interval

[19] A similar approach was used by Edward J. Taaffe, and others: The Peripheral Journey to Work, A Geographic Consideration (Evanston, Ill., 1963), pp. 36ff.

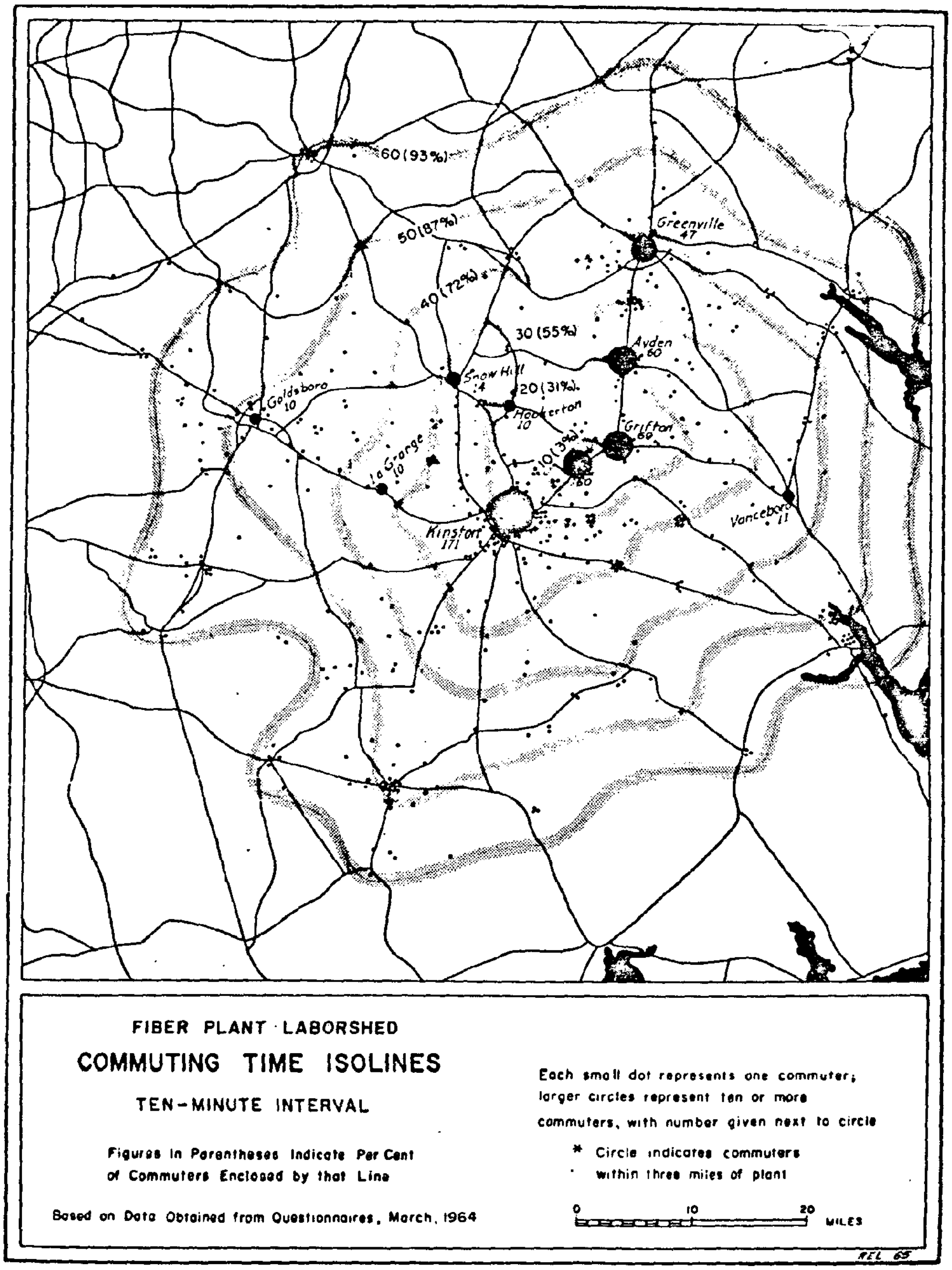

FIG. 7.

(rather than ten as in Figure 7) only because a regression analysis indicated a commuting time of 1.25 minutes per additional mile; 1.25 times 5 miles equals 6.25 minutes, with six being the closest round number.

In the first series of seven models distance is measured in miles. The

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Economic Geograph
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Zone	Miles
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2......	5–9
3......	10–14
4......	15–19
5......	20–24
6......	25–29
7......	30–34
8......	35–39
9......	40–44
10......	45 & over
Total..............	
Coefficient of geographic tion with actual distribu	

distribution of commuters suggested in each of these models is shown by distance zones in Table VII. The distributions are expressed as percentages of the 74-township total. For each model the coefficient of geographic association[20] is calculated, measuring the degree of coincidence between the distribution suggested by the model and the actual distribution of commuters by distance zones.

Model one assumes that distance retards commuting in direct proportion to mileage. This is the most elementary formulation of the gravity concept; $c = p/d$ with c representing the number of commuters, p the population of the township under consideration, and d the distance in miles from the township's population center-of-gravity to the plant (read from Fig. 5). Model one suggests that there are more commuters from the more distant zones and somewhat fewer from the nearer zones than is actually the case. In other words, the retarding effect of distance is understated beyond 25 miles, and overstated closer in. Nevertheless, a reasonably high (.851) coefficient of geographic association is attained.

In the second model the frictional effect of distance in discouraging commuting is increased by squaring the distance. This formulation, $c = p/d^2$, is rather commonly employed by those constructing gravity models.' In this instance the negative influence of distance is grossly exaggerated, and the coefficient of geographic association is a poor .728. In all but the two closest zones the suggested number of commuters is understated.

Model three seeks a better fit by attempting to combine the approaches in the two previous models. Since model one's suggested commuters in the closer zones were somewhat below but close

[20] In this study the coefficient of geographic association is used to compare the geographic distribution of commuters suggested in a probability model with the actual distribution by distance zones, expressed in percentages of the total. Percentage values for each zone in one distribution are subtracted from values in the other, and the sum of the positive (or negative) differences divided by 100 is then subtracted from one. All coefficients will have a value somewhere between zero and one; zero signifies a complete lack of association, and a value of one indicates a perfect association. For a discussion of this measure see Walter Isard: Methods of Regional Analysis (New York, 1960), pp. 253, 255; or John W. Alexander: Economic Geography (Englewood Cliffs, 1963), pp. 595–597.

TABLE VII

DISTRIBUTION OF FIBER PLANT COMMUTERS SUGGESTED BY PROBABILITY MODELS
(Distance measured in miles)

Zone	Miles	*Actual distribution Per cent*	*Model 1 Per cent*	*Model 2 Per cent*	*Model 3 Per cent*	*Model 4 Per cent*	*Model 5 Per cent*	*Model 6 Per cent*	*Model 7 Per cent*
1......	0–4	7.56	6.12	24.74	9.30	1.64	1.69	7.00	7.63
2......	5–9	31.86	27.52	41.96	41.85	19.69	20.29	31.52	34.37
3......	10–14	15.77	8.62	8.78	13.11	9.27	9.55	9.88	10.77
4......	15–19	7.57	5.76	4.05	8.79	8.95	9.29	6.63	7.21
5......	20–24	13.29	13.13	7.17	17.12	21.18	20.33	13.73	13.73
6......	25–29	2.59	3.83	1.81	2.78	5.34	4.91	3.60	3.31
7......	30–34	3.79	6.17	2.46	2.20	7.27	6.79	5.30	4.60
8......	35–39	11.22	16.96	5.68	3.27	16.74	16.53	13.45	11.18
9......	40–44	4.54	5.42	1.61	.75	4.76	4.97	4.13	3.36
10......	45 & over	1.82	6.48	1.75	.78	5.17	5.69	4.79	3.85
Total................		100.01	100.01	100.01	99.95	100.01	100.04	100.03	100.01
Coefficient of geographic association with actual distribution			.851	.728	.830	.754	.763	.919	.934

to the actual, model three assumes that the number of commuters decreases directly with distance up to a range of 20 miles; beyond that the distance is squared just as in model two. Overall, the result is an improvement over model two, with a .830 coefficient of geographic association, but the number of commuters in the more distant zones is even more severely understated.

In models four and five, a different approach is used; a frictionless zone is assumed. It is reasoned that since the average fiber plant worker drives over 17 miles, and since over one-fourth of all workers drive 20 miles or more, perhaps distance seriously discourages commuting only beyond a certain point. Twenty miles was selected, somewhat arbitrarily (but with the distribution in model one in mind), as the outer limit of this frictionless zone. In model four, calculations all distances over 20 miles are squared, and distances up to 20 miles all assigned a value of 400 (20 squared). In model five, distances over 20 are tripled, and distances up to 20 miles all assigned a value of 20. The suggested distribution of commuters by distance zones is about the same in both models; the number of short-distance commuters is badly understated, with the result that the suggested number of medium and long-distance commuters is generally too high. In this instance it appears that the assumption of a frictionless zone is inappropriate.

Model six abandons any assumption that there is a frictionless zone or that distance discourages commuting proportional to some power (e.g., the square) of the mileage. At the same time, it is recognized that the retarding effect of distance is accelerated toward the outer margin of the labor-shed. In model six calculations, commuting is assumed to diminish directly with distances up to 20 miles, and beyond that at a pace proportional to twice the mileage (e.g., a distance of 30 miles would be assigned a value of 20 + 10 x 2 = 40). Employing this approach, a quite favorable .919 coefficient of geographic association is obtained. Nevertheless, the proportion of longer-distance commuters was sufficiently overstated to warrant continued experimentation.

Model seven utilizes the same approach as model six, but the frictional effect of distance beyond 20 miles is increased. Commuting is assumed to diminish directly with mileage up to 20 miles, and beyond that at a pace proportional to three times the mileage. In this case the suggested percentage of commuters from each mileage zone is close to the actual distribution, and a very favorable .934 coefficient of geographic association is realized. The restraining effect of mileage could be further restated in subsequent models and the coefficient of association probably improved somewhat, but the approximate significance of mileage would appear to be already evident.

Another set of five models was constructed. These differ from the others in that distance is measured in terms of commuting time (Table VIII). It was reasoned that it might be possible to achieve a better fit using this distance measure, and, if so, it might suggest that time is a better measure of commuting distance than mileage.

Models eight and nine, patterned after models one and two, employ the two most standard formulations of the gravity concept. In model eight distance is assumed to retard commuting in direct proportion to the number of minutes, and in model nine in direct relation to the square of the number of minutes involved. Model eight results are inferior to those of model one; the proportion of commuters beyond 35

TABLE VIII

Distribution of Fiber Plant Commuters Suggested by Probability Models

(Distance measured in minutes)

Zone	*Minutes**	*Actual distribution Per cent*	*Model 8 Per cent*	*Model 9 Per cent*	*Model 10 Per cent*	*Model 11 Per cent*	*Model 12 Per cent*
1.........	6–11	7.56	3.37	10.39	4.10	9.31	35.63
2.........	12–17	30.35	21.28	35.54	25.85	58.73	33.42
3.........	18–23	12.74	6.25	8.53	7.59	14.78	6.61
4.........	24–29	9.30	6.03	6.24	7.31	4.91	3.99
5.........	30–35	8.64	7.42	6.53	9.01	3.35	3.86
6.........	36–41	9.94	12.59	9.33	13.78	3.38	5.01
7.........	42–47	4.32	7.07	4.31	5.95	1.19	2.22
8.........	48–53	10.37	20.60	11.76	15.85	2.80	5.72
9.........	54–60	6.79	15.40	7.34	10.53	1.57	3.54
Total..................		100.01	100.01	99.97	99.97	100.02	100.00
Coefficient of geographic association with actual distribution..................			.758	.900	.849	.678	.689

*The "0–5" minute zone is considered nonexistent. As indicated by the regression line in Figure 3, it requires about six minutes to travel zero miles; this is presumably a measure of terminal time.

miles is badly overstated, and within 35 miles understated. By contrast, the results in model nine are immensely superior to those of the unsuccessful model two. While the values for the two closest zones are significantly high, a favorable (.900) coefficient of geographic association is attained.

Model ten uses the highly effective model seven as a guide; distance is assumed to restrain commuting directly as the number of minutes up to 35 (as suggested by model eight), and beyond that at the rate of three times the number of minutes. Model ten did not achieve model seven's measure of success, and recorded a fair (.849) coefficient of geographic association.

Model eleven attempts to improve on model nine by adjusting the assumed frictional effect of distance. In model nine the suggested values were high up to 18 minutes. Therefore, in model eleven distance is presumed to retard commuting directly as the number of minutes up to 18, and beyond that at the rate of the square of values in excess of 18 (e.g., 25 minutes would be assigned a value of 18 + 7 squared, or 67). The results provide an example of how a seemingly minor adjustment can severely change suggested distributions; model eleven registers a very poor (.678) coefficient of geographic association.

One final model was constructed. In the previously discussed regression analysis comparing commuting mileage with minutes, a "terminal time" of about six minutes was indicated. Perhaps a superior measure of distance would be attained by subtracting six minutes from all indicated commuting times, thus specifying the time elapsed while actually travelling. Otherwise, model twelve is similar to the successful model nine, i.e., commuting is assumed to be discouraged in direct proportion to the square of the distance. The results in this model are disappointing; the very poor (.689) coefficient of geographic association suggests that the subtraction of "terminal time" is unwarranted. Despite the failure of attempts to improve on model nine, the best in this group, it must be assumed that continued experimentation could in all likelihood produce a somewhat closer fit.

The construction of the probability models demonstrates that geographic distributions similar to the actual ones can be approximated, lending some credence to the assumption that the number of commuters will vary directly with population and inversely with distance from a specified point. The significance of an irregular population distribution as a factor contributing to an uneven geography of commuter origins is evident in the models. Less obvious is the specific impact of distance on commuting. The fact that a very high fit was attained in model seven suggests that in this area distance does exert a greater restraining influence beyond about twenty miles, perhaps proportional to thrice the mileage beyond that point. As to whether the number of miles or the number of minutes is the better measure of distance, there is little evidence here to support one over the other, even though a somewhat better fit was obtained using mileage.

THE CONSIDERATION OF OTHER GEOGRAPHIC VARIABLES

Population and distance are not the only geographic variables which probably have a bearing on the spatial pattern of commuter origins. This would partially explain the difficulty in constructing models which consider only these two variables. When probability model distributions were compared with actual distributions, discrepancies were noted. For example, a particular distance zone may be supposed to generate a specified number of commuters according to some model, but in fact provides only a few. Perhaps some other factors are causing the distance zone to supply fewer commuters than would be expected on the basis of the population-distance relationship built into the model. As can be seen in Table I, there are sizable differences among labor-shed counties in such matters as rates of population growth, urbanization, intensity of agricultural and manufacturing employment, per capita income, wages, levels of unemployment, and density of paved roads. One might consider other factors, such as levels of education, land tenancy, and farm abandonment. All of these factors and many more may have some influence on the tendency or willingness of workers to commute.

As a means of observing the possible significance of some of the variables noted above, Table IX was prepared, comparing the actual number of fiber plant commuters from each of nine counties with the number suggested in probability model seven, the model achieving the highest coefficient of geographic association. Model seven values are treated as the "expected norm," and the percentage deviation of the actual number from that expected in model seven is indicated. The southern counties provide many more commuters than model seven suggests, and the northwestern counties quite the reverse. The deviations were compared with the county data presented in Table I. Clearly evident is a reasonably high correlation between these deviations (actual from expected commuters) and at least three geographic variables: per capita income, population density, and intensity of agricultural employment. To facilitate regional comparisons, for each of the four variables the nine counties are ranked, one through nine (Table IX). In the case of agricultural employment, where the correlation is negative, the ranking is given in inverse order to maintain concordance.

The similarity of the four rankings shown in Table IX is sufficient to suggest that these three geographic variables may have a significant effect on the commuting pattern of fiber plant workers. The moderately high rank correlation coefficients attained (+.57 to

TABLE IX

Some Geographic Variables Possibly Responsible for Discrepancy Between Model Seven and Actual Distribution of Fiber Plant Commuters

County[a]	*Number of commuters suggested in Model 7*	*Actual number of commuters*	*Percentage deviation, actual from suggested*	*Rank,[b] deviation of actual from suggested (negative to positive)*	*Rank,[b] 1962 per capita income[c]*	*Rank,[b] 1960 population density[c]*	*Rank,[b] percentage of 1960 labor force in agriculture[c] (inverse order)*
Central Counties							
Lenoir	435	368	−15	3	3	3	3
Pitt	203	261	+29	7	5	4	6
Greene	56	57	+2	5	6	6	9
Northwestern Counties							
Wayne	88	73	−17	2	4	2	4
Wilson	31	7	−77	1	2	1	2
Southern Counties							
Duplin	19	51	+168	9	8	7	7
Jones	13	23	+77	8	9	9	8
Eastern Counties							
Beaufort	19	19	0	4	7	8	5
Craven	54	64	+19	6	1	5	1
Spearman's rank correlation coefficient with figures in fourth column					+.62	+.73	+.57

[a] Only those counties within a one-hour commuting distance (arbitrary cut-off point in probability models) are considered.
[b] Rank among nine counties here considered.
[c] Derived from data in Table I.

+.73) would be much higher were it not for Craven County's sizable rank inconsistency. Craven is unique among study area counties in that it possesses a large military installation (Cherry Point Marine Air Station) employing large numbers of civilians, thus explaining in part that county's higher per capita income and lower intensity of agricultural employment.

The generation of greater than expected numbers of commuters from lower-income counties[21] tends to substantiate the observation made earlier that when a manufacturing plant offers wages appreciably above those prevailing in a region, one can expect the workers to show a greater willingness to commute longer distances. The data for Duplin and Jones counties in Tables I and IX suggest that the greater the positive difference between a plant's wages and those prevalent in an area, the greater the distance workers will be willing to travel. The counties with the highest percentage of the labor force in agriculture are also the counties with lower per capita incomes and stagnant or declining populations; such conditions are indicative of poor or declining agricultural opportunities and presumably stimulate commuting.[22]

Summary

The commuting pattern of the higher-wage fiber plant workers contrasts sharply with that of the lower-wage shirt factory employees. The former commute a mean distance of 17.5 miles each way, while the latter average 6.7 miles. Where the two labor-sheds are outlined to encompass the "nearest 90" per cent of the respective commuters, the fiber plant labor-shed covers

[21] Further evidence of such a relationship can be seen in Figure 6 which shows the distribution of shirt workers. Duplin County, where the average income is particularly low, supplies many more workers than other higher-income counties equidistant from the factory.

[22] The greater tendency of workers to commute where agricultural conditions are poor was observed in upstate New York by Harold E. Conklin: The Rural-Urban Economy of the Elmira-Corning (N.Y.) Region, *Journ. Land and Public Utility Economics*, Vol. 20, 1944, p. 3.

about three times the area. Commuting isolines provide a promising means of delimiting labor market areas; this permits the labor-shed to be conceived as a region diminishing by degree rather than terminating abruptly at some arbitrarily-designated limit. Commuting isolines can be based on miles or minutes, but the additional effort required to obtain data on travel time in itself recommends the use of mileage in constructing isoline maps. As to the question of which is the better measure of commuting distance—miles or minutes—the evidence in this study, while inconclusive, does suggest that there is relatively little advantage in one over the other.

Wages appear to be the primary factor explaining the acute differences in the two commuting patterns. Wages at the fiber plant are, like their commuting distances, much above the average for the state and the ten-county study area. Within the fiber plant group, there is no correlation between wages and distance, but the critical point here may be that almost all fiber plant workers receive a wage above the study-area average. The shirt factory workers, with a below-average wage, commute a distance somewhat under the state mean. The prevalence of female workers at the shirt factory does not explain the variance in distance, as there are no apparent differences in the commuting habits of men and women in this area. A firm considering a location in this or a similar district should compare its wage standards with those prevailing in the area before making estimates on the size of the labor-shed from which it can expect to draw labor.

A series of probability models based on gravity concepts provided a useful method of appraising the importance of two geographic variables, population and distance. The positive relation between the irregular population distribution and the uneven geographic pattern of commuter origins is effectively indicated by the high degree of association between the distributions of commuters suggested by some models and the actual geographic distribution. The apparent significance of distance in retarding commuting in this section of eastern North Carolina was approximated through a lengthy process of experimentation with assorted valuations of distance in the probability models.

Discrepancies between the actual distribution of commuters and those designated by the more successful models are possibly explained by spatial differences in other conditions. Districts generating more commuters than a model suggests tend to be areas with a high percentage of the labor force in agriculture, low per capita income, low population density, and little if any recent population growth. In the final analysis, an appraisal of any commuting pattern requires a consideration of a multitude of interrelated geographic variables.

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CAPITAL

Dr. Logan i

THE distribu activities in concentratec ital city nodes. Tl pattern to be expec Western country tha six Sovereign States. particular, is heavily distribution pattern portance of various f intervention and mo tion in Australian ge of this paper are to turing distribution a city levels and to dis specialization of fun veloped. Because of the distribution, simp niques based on the facturing employees l

Manufacturing is c states, New South W and in the capital cit both respects its d is more concentrated lation. Whereas New Victoria in 1961, 65 per cent of the r they contained 74 manufacturing jobs. tion in 1901, Victori

[1] See, for example, T. nomic Organisation of 1953); R. Vining: A Spatial Aspects of an E *Dev. and Cul. Change*, V J. R. P. Friedmann: Economic Development No. 3, 1956, pp. 213–22