Effect of auto plant openings on net migration in the auto corridor, 1980–97

Thomas H. Klier and Kenneth M. Johnson

Introduction and summary

How do newly opened auto plants influence the patterns of demographic change in an area? An answer to this question has important policy implications. Competition among communities to attract new manufacturing jobs is substantial. Local governments often provide significant economic incentives to firms to induce them to locate a new plant in a given community. Such financial commitments are often justified, in part, by the argument that new jobs will aid the community in retaining its population, particularly its young adult population. The young population is viewed as critical to the future of communities because it represents a significant amount of human capital. In that context, we believe it is important to document the impact that such industrial development has on the local demographic structure. We would expect such demographic change to be most evident in the patterns of migration to and from the respective counties.

Our research links demographic trends of the last two decades to the geographic dispersion of the auto industry. The analysis focuses on the nonmetropolitan areas of seven states that make up the core of the auto industry. This "auto corridor" includes 66 percent of the employees and 70 percent of the plants engaged in the production of cars and light trucks in the U.S. Our primary interest is in estimating the impact that the presence of auto plants has on the pattern of migration in the immediate and proximate counties. We accomplish this by combining county-level migration data with data on the spatial and longitudinal distribution of auto industry plants. Our auto industry dataset is unique, consisting of plant-level information for auto assembly plants plus data on the notoriously hard-to-track auto supplier plants. It encompasses over 2,200 individual plants, representing just under 900,000 employees for the seven auto corridor states. Such comprehensive coverage of this industry represents a significant contribution to the literature.

Our models estimate the impact of auto plants on county-level net migration during the 1980s and 1990s. Explanatory variables include measures of economic, locational, and demographic characteristics and several variables measuring the presence and structure of auto plants within and proximate to the county.

Consistent with previous empirical work, we find that a set of background variables widely used in demographic research accounts for the bulk of the variation in county-level migration. However, including variables measuring the presence and addition of auto plants does add to the explanatory power of the model. The addition of a large plant to a county appears to have a significant positive influence on migration. This effect is evident not only in the county where the plant locates, but also in the contiguous counties. The effect of smaller plants is much more limited, but it is in the expected direction.

Review of the literature

Our work draws on several strands of literature. First, we examine demographic trends between 1980 and 1997. Review of such timely information is important, because metropolitan and nonmetropolitan demographic trends have been extremely fluid during the past 30 years in the nation as a whole (Long and DeAre, 1988; and Frey and Johnson, 1998).

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Historically, nonmetropolitan demographic change both in the auto corridor and elsewhere in the U.S. has been dominated by an excess of births over deaths sufficient to offset the net outmigration of population to metropolitan areas. This pattern of slow nonmetropolitan population gain through an excess of natural increase over migration loss was so consistent that it came to be taken for granted (Fuguitt et al., 1989). However, the pattern changed abruptly in the 1970s with the onset of what came to be called the nonmetropolitan population turnaround. Nonmetropolitan areas experienced widespread and substantial population gains and net inmigration during the turnaround (Beale, 1975; Johnson and Purdy, 1980; and Fuguitt, 1985). Nonmetropolitan population redistribution patterns shifted again in the 1980s. Most nonmetropolitan counties lost population during the decade because they had a modest net outflow of population combined with low levels of natural increase (Johnson, 1993). Many researchers regarded the diminished nonmetropolitan growth of the 1980s as evidence that U.S. population redistribution trends had reverted to historical form, with the turnaround of the 1970s being just a short-term fluctuation. Yet, there is now evidence of another upturn in population growth rates in nonmetropolitan areas during the late 1980s and 1990s (Johnson and Beale, 1994; and Johnson, 1998). Our purpose here is to examine the linkages between such demographic change and trends in the spatial structure of the auto industry.

The U.S. auto industry has undergone major changes during the last 30 years (see McAlinden and Smith, 1993; Rubenstein, 1992; and Harbour, 1990). Three developments have shaped the spatial pattern of the industry during this period—the reconcentration of auto assembly facilities in the heart of the country, the southward expansion of the traditional Midwest Auto Belt, and the arrival of Japanese auto assembly and parts plants.

The spatial changes affecting the auto industry have been reported in Rubenstein (1992). Most notable is the reconcentration of auto assembly facilities in the heart of the country. In the early days of the industry, assembly plants were built close to population centers, since it was cheaper to ship parts to assembly plants than to ship finished vehicles across the country. This approach worked well as long as consumer demand for specific models was sufficient to support production at multiple assembly plant locations. However, since the 1960s, the proliferation of different models of cars has far outstripped the growth in overall production of vehicles. As a result, particular models must now be produced and shipped from only one or two assembly plants if they are to be profitable. This development has led many companies to concentrate their assembly plants in the heart of the U.S. to minimize the costs of distributing the final product to a national market. It also allows the assembly plants to be located near the plants that produce engines, transmissions, drive trains, and a host of other components. The net result of this trend has been the closing of many coastal assembly plants and the reconcentration of light vehicle assembly plants in the auto corridor (see table 1).

As the auto industry reconcentrated in the nation's heartland, much of the growth occurred in the historical Auto Belt around Detroit. However, the industry simultaneously expanded southward, forming an auto corridor that includes not only the traditional auto states of Michigan, Illinois, Indiana, Wisconsin, and Ohio, but also Kentucky and Tennessee. This southward extension of the auto corridor started in the 1970s with efforts by General Motors to lower procurement costs by building component plants south of the traditional auto region. Facilitating the southward expansion of the auto corridor was the arrival of Japanese-owned assembly and supplier facilities during the 1980s (see table 2) (see Kenney and Florida, 1992; McAlinden and Smith, 1993; Smith and Florida, 1994; and Head et al., 1995).[1] Plant location decisions by Japanese car companies reflect a preference for greenfield locations on the southern periphery of the traditional Auto Belt. Hence Kentucky and Tennessee more than tripled their share of light vehicle assembly plants, from 4 percent to 13 percent, while the other five states of the auto corridor increased their overall share from 43 percent to 50 percent between 1970 and 1997 (table 1).

TABLE 1

Reconcentration of light vehicle assembly plants

	Plants operational in			
Auto corridor	**1970**		**1997**	
	Number	(%)	Number	(%)
Illinois	2	(4)	3	(5)
Indiana	0	(0)	2	(4)
Kentucky	2	(4)	5	(9)
Michigan	15	(29)	15	(27)
Ohio	3	(9)	7	(13)
Tennessee	0	(0)	2	(4)
Wisconsin	2	(4)	1	(2)
Total	24	(47)	35	(63)
U.S. total	**51(100)**		**56(100)**	

Source: *Ward's Automotive Yearbook*, various years.

TABLE 2

Newly opened light vehicle assembly plants, 1980–97

Company	State	Start-up year
GM	Kentucky	1981
GM	Louisiana[a]	1981
GM	Ohio	1981
Honda	Ohio	1982
Nissan	Tennessee	1983
NUMMI[b]	California[a]	1984
GM	Michigan	1984
GM	Missouri[a]	1984
GM	Michigan	1985
AutoAlliance[b]	Michigan	1987
DiamondStar	Illinois	1988
Toyota	Kentucky	1988
Honda	Ohio	1989
Subaru-Isuzu	Indiana	1989
Saturn	Tennessee	1990
Chrysler	Michigan	1991
Ford	Ohio	1991
BMW	So. Carolina[a]	1994
Toyota	Kentucky	1994
Mercedes-Benz	Alabama[a]	1997

[a]Indicates state not in auto corridor.
[b]Reopened previously closed facility.
Source: ELM Guide database, 1997.

Several papers examine the economic impact of locating an auto assembly facility on the proximate areas (see Haywood, 1998; Center for Business and Economic Research, 1992; Fournier and Isserman, 1993; and Marvel and Shkurti, 1993). These studies examine the balance between the incentives used to attract a plant and the resulting development of the region as measured by income and employment. Their findings suggest that adding an assembly plant can have spatially disparate effects on growth. For example, the host county for a Honda assembly plant that opened in Ohio in 1982 experienced much stronger employment and income growth than the contiguous counties (Fournier and Issermann, 1993). At the state level, the impact of attracting an assembly plant depends on the timing of a particular plant relative to others in a region. Murray et al. (1999) suggest that spinoff effects derived from the subsequent location of supplier facilities near new assembly plants are strongest in areas that were first to attract an automobile assembly plant. The economic development literature, however, provides very little evidence on possible linkages between plant location and demographic trends. Two studies of the impact of new assembly plants suggest that approximately 80 percent of those who migrated to obtain work in the newly opened assembly plants came from within the same state (Elhance and Chapman, 1992; and Marvel and Shkurti, 1993).

In sum, the literature suggests there have been significant shifts in the demographic trends in the auto corridor during the past three decades. During the same period, the auto industry has experienced a reconcentration of activity in the auto corridor and a simultaneous southward expansion of this corridor. The literature provides some evidence that the opening of new auto plants has an impact on the economic and, perhaps, the demographic character of the proximate area. Our purpose here is to more clearly delineate the linkages between recent spatial shifts in the location of the auto industry and demographic change in the seven auto corridor states, using new data on the distribution of auto industry plants.

Data and procedures

We use data on demographic change since 1990 from the *Federal–State Cooperative Population Estimates* series, developed jointly by the U.S. Bureau of the Census and the states. Additional data are from the U.S. decennial censuses of population for 1970, 1980, and 1990. Births and deaths for 1980 to 1990 are from special tabulations of the *Federal–State Cooperative* series. The typology used to classify counties by economic function was developed by the Economic Research Service of the U.S. Department of Agriculture (Cook and Mizer, 1994). The recreational specialty variable is from Beale and Johnson (1998). We calculate net migration by subtracting natural increase from the population change during the appropriate period.

Counties are the unit of analysis and are appropriate for this purpose because they have historically stable boundaries and are a basic unit for reporting fertility, mortality, and census data. This article focuses on the auto corridor, which is defined as the following seven states: Illinois, Indiana, Michigan, Ohio, Kentucky, Tennessee, and Wisconsin. There are 652 counties in the auto corridor, with a total population of 53.1 million people in 1997. This region encompasses about two-thirds of the total number of light vehicle assembly and supplier plants in the U.S. (see table 3).[2]

Metropolitan reclassification complicates our efforts to compare the trends of various periods. We use the latest (1993) metropolitan definition to classify counties as metropolitan or nonmetropolitan. According to this definition, there were 455 nonmetropolitan

TABLE 3

Auto corridor share of auto industry, 1997

	Plants		Employment	
	Number	(%)	Number	(%)
Major plants	156	(72)	353,392	(70)
Independent suppliers	2,043	(68)	533,808	(60)
Total	**2,199**		**887,200**	

Notes: Major plants are light vehicle assembly plants and captive supplier plants. Numbers in parentheses indicate percent of U.S. total.
Sources: ELM Guide database, 1997; various state manufacturing directories, 1997

counties in the auto corridor and 197 metropolitan counties in the auto corridor. Because counties are reclassified from time to time as new metropolitan areas are formed or territory is added to existing areas, the demographic implications of using one definition of metropolitan areas in preference to another are far from trivial (Johnson, 1989). There is no simple resolution to the problem of metropolitan reclassification nor is any one approach clearly superior to all others (Fuguitt et al., 1988). Using the 1993 definition results in greater nonmetropolitan losses during the 1980s and slower nonmetropolitan gains during the early 1990s than would have been the case had we used the earlier metropolitan definition.[3]

We use auto industry data from the ELM Guide database, a set of plant-level data developed by a private company in Michigan. This database includes information on auto assembly facilities, supplier plants owned by assembly companies (so-called captive suppliers), and independent supplier plants (the database focuses on suppliers that deal directly with assembly companies). The data represent the year 1997 and identify, among other variables, for each plant the address, a list of the plant's products, the production processes used, and employment. We obtained information on the plants' start-up year from various state manufacturing directories and the plants themselves. The data represent over 2,200 individual plants and approximately 900,000 employees.[4] While the data are very comprehensive for the year 1997, due to their cross-sectional nature, they do not include information on plant deaths during the period analyzed. In other words, all information on plant opening years is conditional on the plant surviving through 1997, leading to *survivor bias* in the data. (See box 1 for an explanation of the implications of this data problem.)

Descriptive statistics

Demographics in the auto corridor

In a reversal of the trend of the 1980s, there was widespread population growth in nonmetropolitan areas of the auto corridor during the 1990s. More than 87 percent of the 455 counties in the auto corridor classified as nonmetropolitan in 1993 gained population between 1990 and 1997 (table 4). In all, 192 more nonmetropolitan counties gained population than in the 1980s. The estimated nonmetropolitan population gain in the auto corridor between April 1990 and July 1997 was 693,000. In contrast, nonmetropolitan areas lost nearly 20,000 in population during the 1980s. Although the nonmetropolitan population gain of 1.3 million in the auto corridor during the 1970s was greater than the gain of the 1990s, this recent gain is substantial compared with any other in recent decades.

The nonmetropolitan population gains are even more surprising given that, historically, the metropolitan areas of the auto corridor have been the major growth centers of the region. Yet, in two of the last three decades, nonmetropolitan growth rates have actually exceeded those in the region's metropolitan areas. The nonmetropolitan population grew at a faster pace (5.7 percent) than the metropolitan population

BOX 1

Survivor bias

The data represents information from 1997 and includes the opening year for individual plants. However, it does not represent time-series information as it only includes plants that were operational in 1997. In other words, the data include survivor bias, because all information on the history of individual plants is conditional on their surviving until 1997. Given that constraint, what assumptions do we make in interpreting the empirical results?

In interpreting the data on spatial distribution of plant location, we assume that plants located in nonmetropolitan counties do not show higher exit rates than plants located in metropolitan counties. If they did, the dispersion of the industry into nonmetropolitan counties during the 1980s and 1990s, as measured by plant openings, would be overstated. To our knowledge, there is no empirical work that could back up this assumption. However, it seems a reasonable assumption to make. In fact, it might be rather conservative in light of the fact that older manufacturing plants tend to be concentrated in urban areas, which might lead to *higher* exit rates for metropolitan county plants.

TABLE 4

Auto corridor population by metro status

	Number of cases	Initial population	Population change: Absolute change	Population change: Percent change	Population change: Percent growing	Net migration: Absolute change	Net migration: Percent change	Net migration: Percent growing	Natural increase: Absolute change	Natural increase: Percent change	Natural increase: Percent growing
1970 to 1980											
Nonmetropolitan	455	10,799,742	1,322,914	12.2	94.3	718,423	6.7	81.8	604,491	5.6	93.0
Metropolitan	197	36,609,737	1,201,872	3.3	87.8	–1,465,839	–4.0	63.5	2,667,886	7.0	100.0
Total	652	47,409,479	2,524,786	5.3	92.3	–747,416	–1.6	76.2	3,272,377	6.9	95.1
1980 to 1990											
Nonmetropolitan	455	12,122,650	–19,966	–0.2	44.8	–544,481	–4.5	23.3	524,515	4.3	91.6
Metropolitan	197	37,811,609	657,130	1.7	70.1	–1,979,479	–5.2	35.0	2,639,609	7.0	99.5
Total	652	49,934,259	637,164	1.3	52.5	–2,523,960	–5.1	26.8	3,164,124	6.3	94.0
1990 to 1997											
Nonmetropolitan	455	12,104,092	693,026	5.7	87.0	441,416	3.6	78.2	251,610	2.1	78.2
Metropolitan	197	38,468,739	1,900,129	4.9	88.3	71	0.0	72.1	1,900,058	4.9	98.0
Total	652	50,572,831	2,593,155	5.1	87.4	441,487	0.9	76.4	2,151,668	4.3	84.2

Note: 1993 metropolitan status used for all periods.
Sources: 1970–90 Census and *Federal–State Cooperative Population Estimates*.

(4.9 percent) between 1990 and 1997. Metropolitan growth did exceed that in nonmetropolitan areas of the auto corridor during the 1980s. However, during the turnaround of the 1970s, nonmetropolitan gains (12.2 percent) exceeded metropolitan gains (3.3 percent) by a substantial margin. Geographically, population gains were widespread in nonmetropolitan areas of the corridor. Population losses were common in the core counties of the older industrial areas of the region.

The renewed nonmetropolitan population growth in the 1990s, as well as the earlier growth during the 1970s, is due, in large part, to migration gains. For example, such migration gains accounted for 64 percent of the total estimated population increase between April 1990 and July 1997. Nonmetropolitan areas had an estimated net inflow of 441,000 people during the period. In contrast, metropolitan areas of the auto corridor experienced no migration gain during the 1990s. This is a sharp contrast to the pattern during the 1980s when both metropolitan and nonmetropolitan areas had net outmigration. The auto corridor's metropolitan areas were particularly hard hit by outmigration during the 1970s and 1980s, losing nearly 3,445,000 people between 1970 and 1990. In comparison, nonmetropolitan areas enjoyed substantial migration gains during the population turnaround of the 1970s. The complex pattern of migration change over the past three decades in the auto corridor is of particular interest here because it coincides with a period of change in the auto industry.

The differential impact of net migration on metropolitan and nonmetropolitan areas is clearly evident when we look at spatial patterns (see figures 1 and 2 where migration patterns are shown). We see migration from both metropolitan and nonmetropolitan areas during the 1980s. Nonmetropolitan counties with net inmigration are located primarily in recreational and high amenity areas in the northern and southern periphery of the seven-state area. Migration from metropolitan counties was also evident, particularly in many of the traditional Auto Belt cities of southern Michigan and northern Ohio. The few metropolitan counties that were growing were in suburban rings around older cities.

There are dramatic changes in the spatial patterns of migration in the 1990s. Nonmetropolitan migration gains are extremely widespread except in agricultural areas near the center of the corridor. We also see a migration recovery in the region's metropolitan counties, though migration losses continued in many cities traditionally associated with car production.

Natural increase accounted for 36 percent of the nonmetropolitan population increase in the auto corridor between April 1990 and July 1997. In all, births exceeded deaths by 252,000 in nonmetropolitan areas. The annualized gain through natural increase in nonmetropolitan areas was somewhat lower between 1990 and 1997 than it had been during the 1980s. In contrast, the annualized rate of natural increase remained constant in the auto corridor's metropolitan regions, and natural increase accounted for all of the metropolitan population increase in the 1990s.[5]

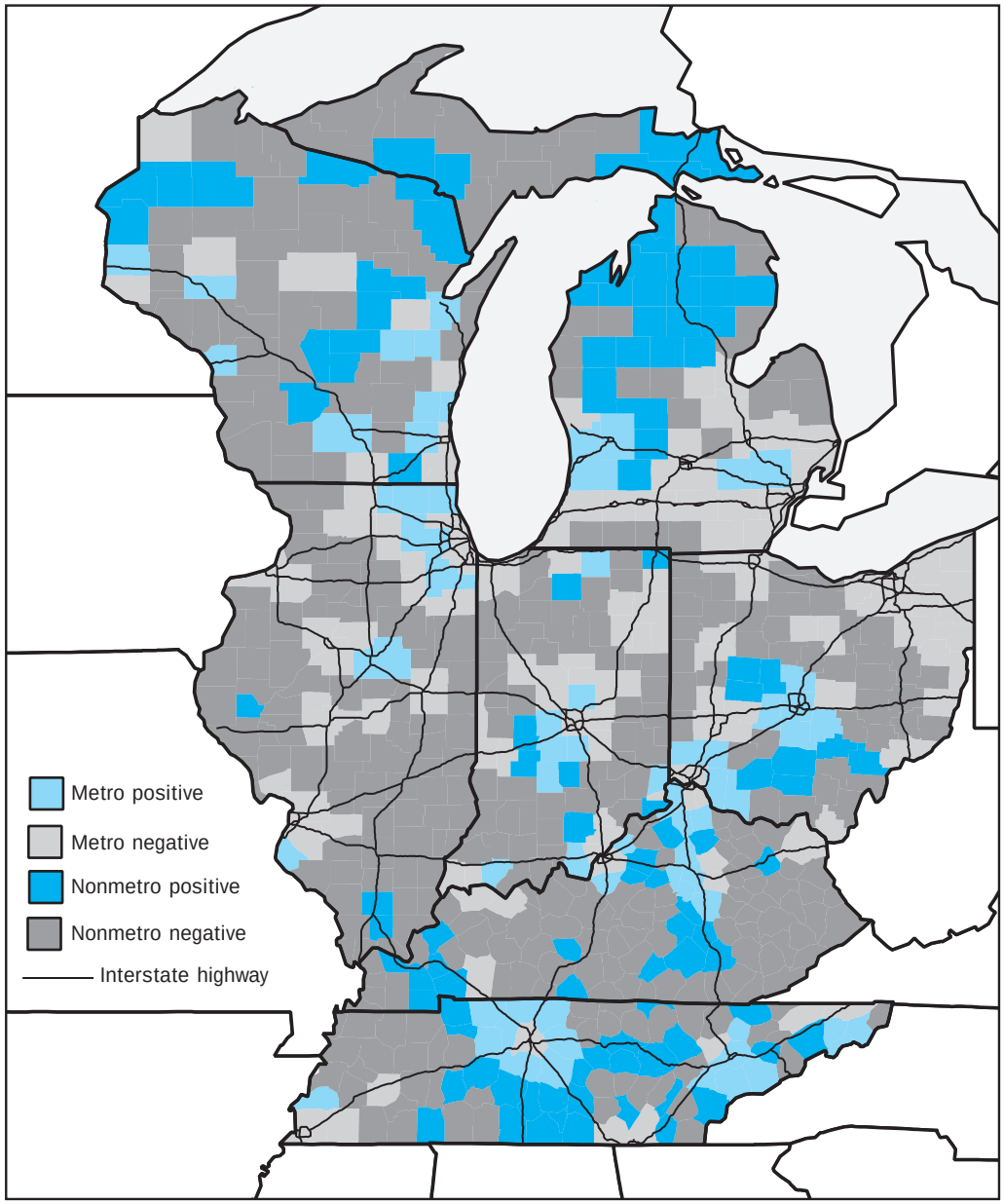
Nonmetropolitan population gains were more likely in counties near metropolitan centers. Nearly 92 percent of these adjacent counties gained population in the 1990s, and 80 percent had net inmigration (table 5). Even among more remote nonmetropolitan counties, recent population gains have been significantly greater than during the 1980s. Growth occurred

in 82 percent of counties not adjacent to metropolitan areas in the 1990s. Such nonadjacent counties had net inmigration (3.7 percent) during the 1990s.

Nonmetropolitan counties that were destinations for retirees or centers of recreation were the fastest growing counties during the early 1990s. All of the 24 nonmetropolitan retirement destination counties in the auto corridor gained population and had net inmigration between 1990 and 1997. These areas, common in the Upper Great Lakes and Appalachians (Cook and Mizer, 1994), are attracting retirees while retaining their existing population (Fuguitt and Heaton, 1993). Population gains also occurred in 95 percent of the 41 nonmetropolitan recreational counties during the 1990s, with a large majority (93 percent) receiving net inmigration. Such counties had been prominent growth nodes during the 1970s and 1980s and the trend persisted in the 1990s. There is

FIGURE 1

1980s net migration for metro and nonmetro counties



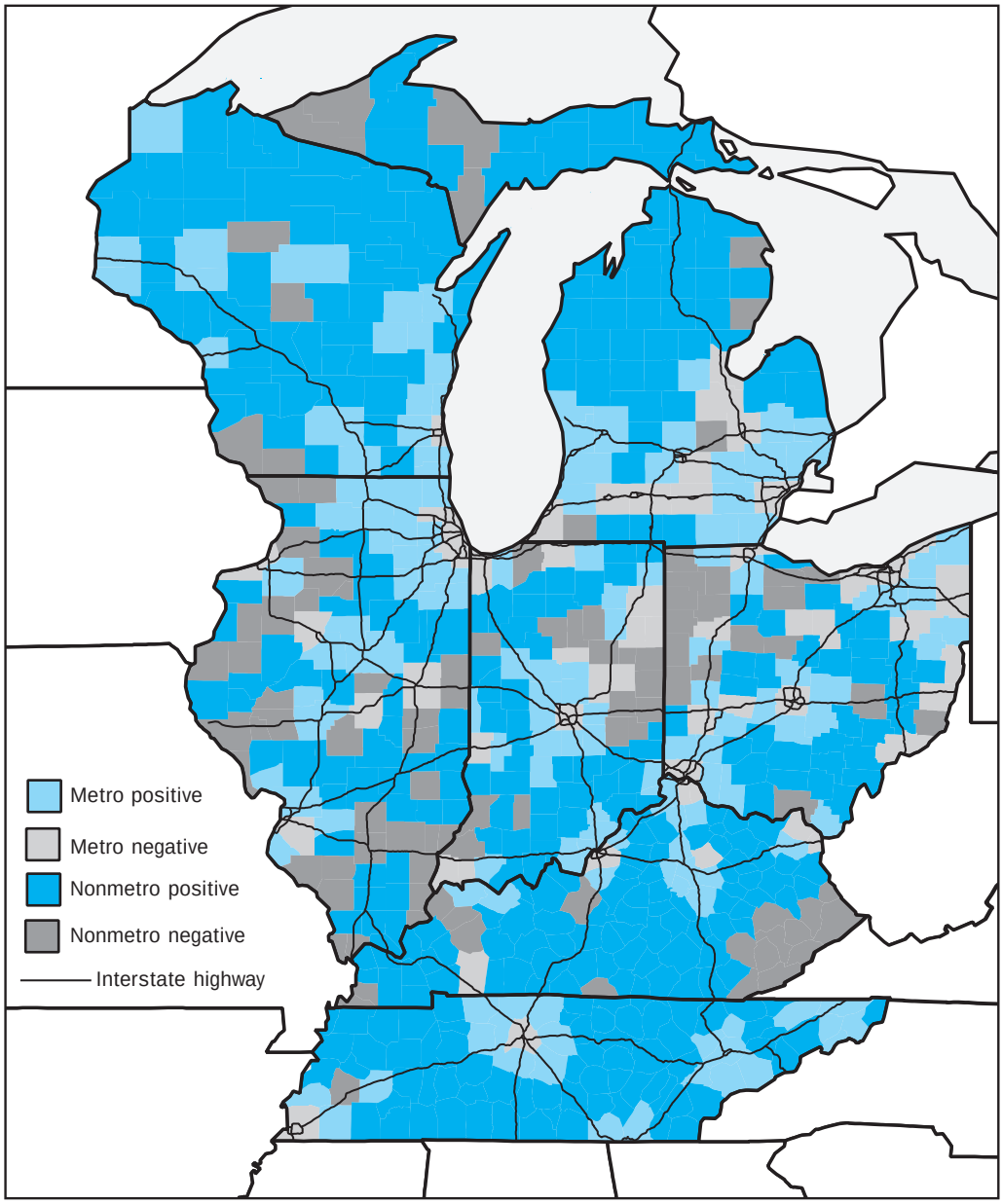
Note: Interstate highways are shown only for the seven auto corridor states.
Sources: 1970–90 Census and *Federal–State Cooperative Population Estimates.*

significant overlap between the recreational and retirement destination counties, because the amenities and scenic advantages that attract vacationers and seasonal residents also appeal to retirees.[6]

Nonmetropolitan population gains were also widespread in manufacturing and commuting counties in the auto corridor, though the gains were smaller than those in recreational and retirement counties. Growth in such counties was more evenly balanced between natural increase and net migration. The proximity of the lower Great Lakes manufacturing belt and the emergence of new industrial areas in the southern part of the region in recent years accounts for the large number (178) of rural manufacturing counties. The expansion of the auto industry during the past several decades has certainly been a factor in this. Both migration gains and natural increase were common in manufacturing counties. A large number of auto corridor nonmetropolitan counties have a substantial share of their labor force commuting to

FIGURE 2

1990s net migration for metro and nonmetro counties



Note: Interstate highways are shown only for the seven auto corridor states.
Sources: 1970–90 Census and *Federal–State Cooperative Population Estimates*.

TABLE 5

Auto corridor population in nonmetropolitan counties, selected variables

	Number of cases	Population change		Net migration		Natural increase	
		Percent change	Percent growing	Percent change	Percent growing	Percent change	Percent growing
Adjacent	241	6.1	92	3.6	80	2.5	87
Nonadjacent	214	5.2	82	3.7	77	1.5	69
Retirement	24	14.7	100	14.0	100	0.7	42
Recreational	41	9.8	95	8.5	93	1.2	63
Manufacturing	178	6.5	93	3.9	80	2.6	88
Commuting	117	7.7	92	5.7	87	2.0	75
Mining	33	0.9	52	–0.7	45	1.6	73
Farming	28	5.0	93	4.2	86	0.9	68
Total nonmetropolitan	455	5.7	87	3.6	78	2.1	78

Notes: 1993 metropolitan definition. Percent change is aggregate change for all cases in category.
Recreational counties defined by Beale and Johnson (1998). All other types defined as in Cook and Mizer (1994).
Nonmetropolitan counties divided into those adjacent to a metropolitan county and those not adjacent.
Sources: 1970–90 Census and *Federal–State Cooperative Population Estimates*.

jobs in other counties, often in proximate metropolitan counties. This allows rural workers to access the urban labor market, while retaining their rural place of residence and lifestyle. The substantial migration gains in such counties reflect their significant appeal.

The 33 counties dependent on mining in the auto corridor were the least likely to gain population during the 1990s. Only 52 percent of these counties gained population and only 45 percent had net inmigration. Population gains were considerably more widespread in farming counties, but the magnitude of the gains was relatively small. The smaller than average population gains for mining and farming dependent counties in the 1990s represents a continuation of the trends of the 1980s. However, even among these counties the population and migration trends moderated in the 1990s compared with the 1980s, when population decline and migration losses were much more prevalent.

Evolving spatial distribution in the auto corridor

Table 6 shows the distribution of auto plant openings for plants surviving through 1997 across time and by county type. It distinguishes independent supplier plants from captive suppliers and light vehicle assembly plants (referred to as "major" plants). Because we do not know the employment history for the plants, we use this distinction to approximate small and large plants. The average independent supplier plant employed 258 workers in 1997, compared with 2,265 for an assembly or captive parts plant.

Table 6 shows the industry's growth during the last three decades as measured by the growth in newly opened independent supplier plants. Their number more than doubled since 1970, with the largest absolute increase occurring during the 1980s. Since 1970, the industry has also spread out within the auto corridor, indicated by the increase in the share of supplier plants located in nonmetropolitan counties from 28 percent in 1970 to 33 percent in 1997. Plant openings among major plants largely reflect the opening of new assembly plants.

TABLE 6

Plant openings across time and county type

	Prior to 1970	Plants opened			Plants open in 1997
		1970s	1980s	1990s	
Independent supplier plants					
Nonmetropolitan	265	110	215	75	665
Metropolitan	653	210	303	212	1,378
Total	918	320	518	287	2,043
Major plants					
Nonmetropolitan	9	0	4	3	16
Metropolitan	104	11	17	8	140
Total	113	11	21	11	156

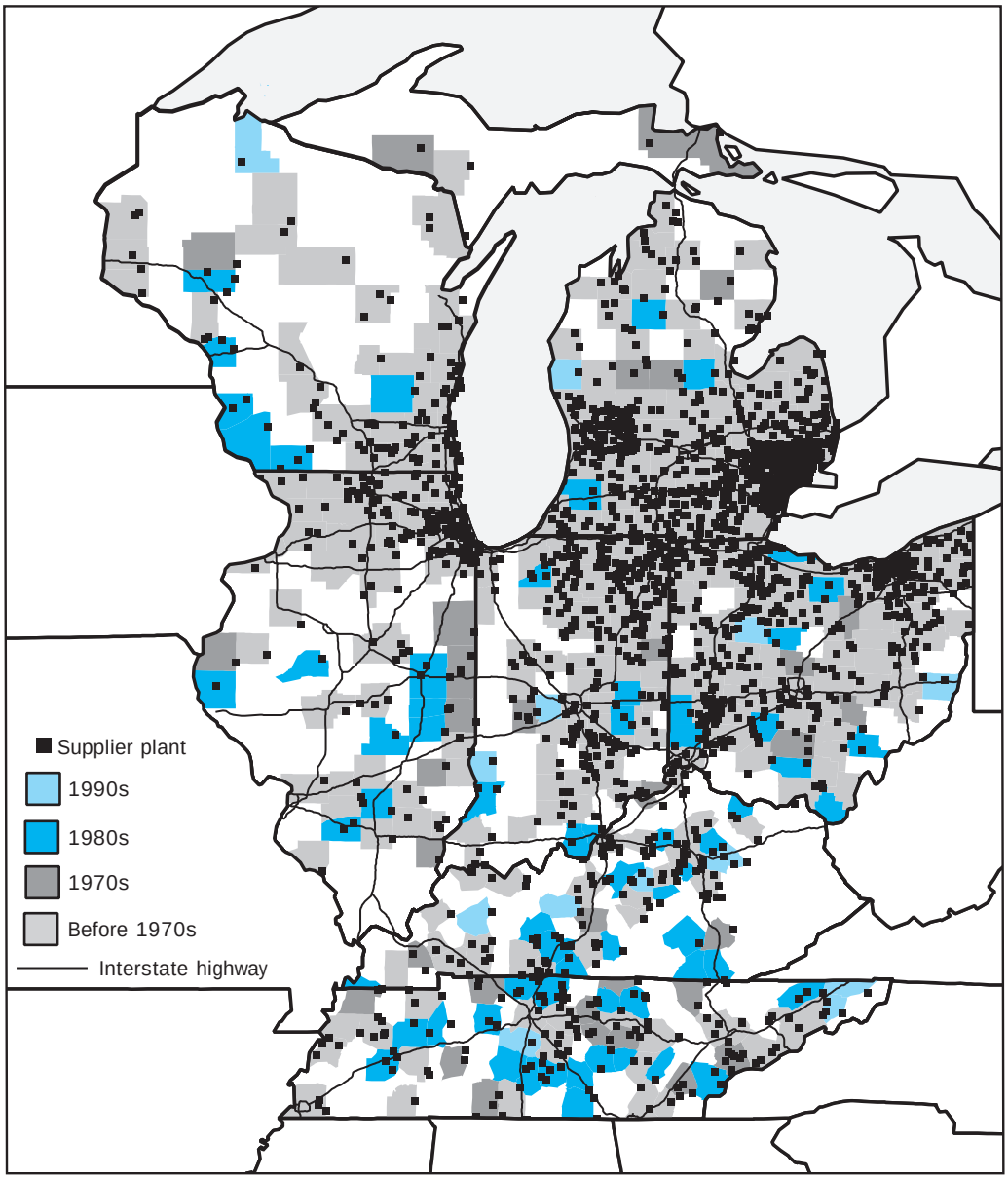
Note: Major plants are light vehicle assembly plant and captive supplier plants.
Sources: ELM Guide database, 1997; various state manufacturing directories, 1997.

As mentioned above, the location choices of auto plants in the corridor states during the last 30 years can be characterized by dispersion as well as southward expansion. Figure 3 shows this development based on our database, using information on start-up years for plants that were in business in 1997. The counties are color-coded to indicate the decade during which the first independent auto supplier plant opened. Finally, figure 3 also shows interstate highways and the density of auto supplier plants in 1997.

Figure 3 shows the core of the industry to be located in southern Michigan, as well as northern Indiana, northern Ohio, and the Chicago area.[7] From there, plants dispersed to the west and north, but mostly to the south. Such dispersion peaked during the 1980s, when 64 counties that did not previously have auto supplier plants gained at least one (versus 34 in the 1970s, and 14 in the 1990s). Most of the newly occupied auto corridor counties were in Kentucky and Tennessee. During the last three decades, the two southern states'

FIGURE 3

Dispersion and plant density of auto suppliers



Note: Interstate highways are shown only for the seven auto corridor states.
Sources: ELM Guide database, 1997; various state manufacturing directories, 1997.

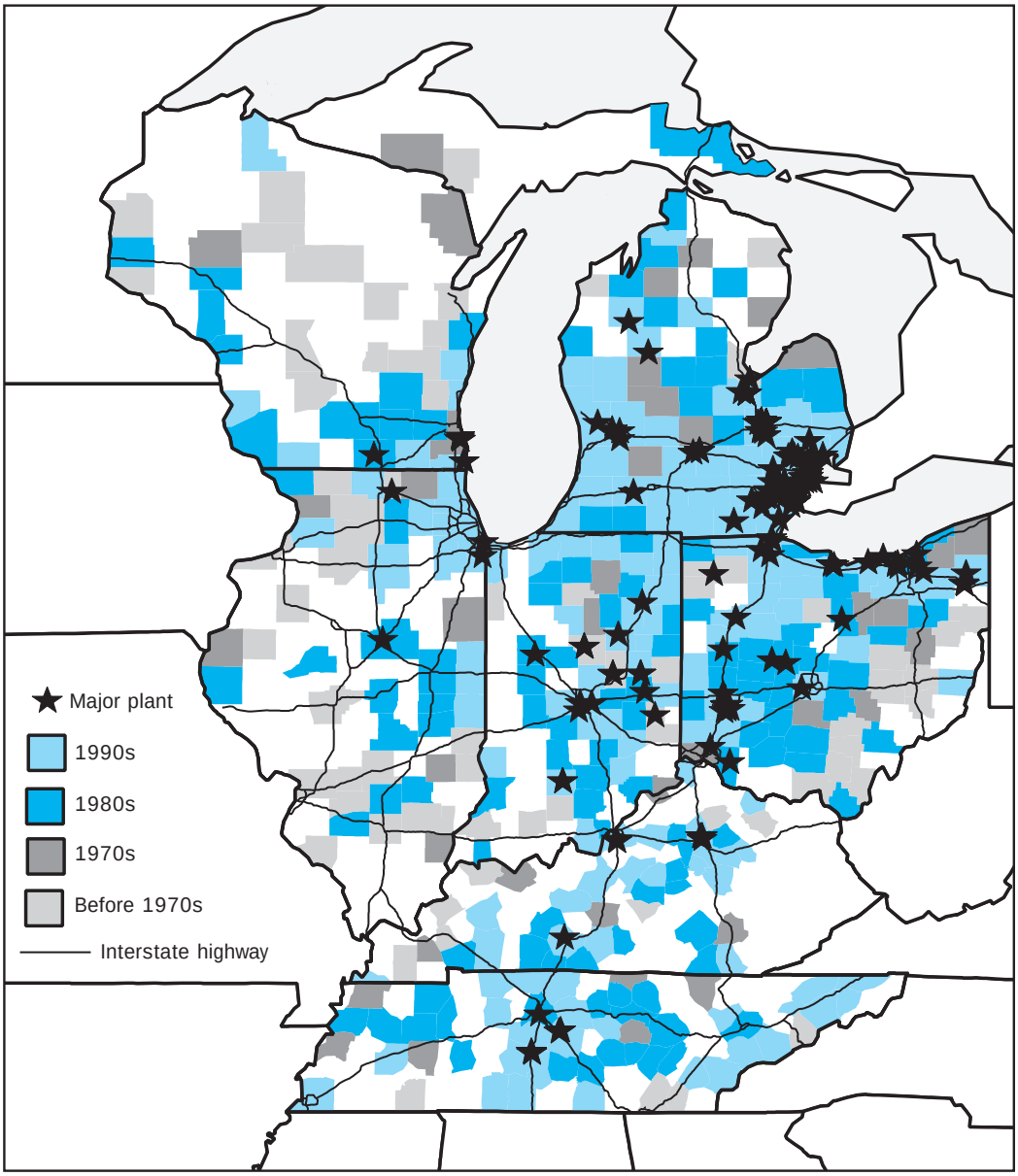
share of newly opened supplier plants has steadily increased from 41 percent in the 1970s, to 53 percent in the 1980s and 57 percent in the 1990s. This trend also holds for new assembly plants (see table 2).

The importance of highway transportation is also evident, especially in the southern half of the auto corridor.[8] Nearly every county with an auto supplier plant is on or near an interstate highway, and supplier facilities cluster around transportation hubs such as Indianapolis and Nashville.

Figure 4 adds a longitudinal perspective to the analysis by showing the year during which the last independent supplier plant was added to a county. It complements figure 3 and demonstrates that the core of the auto corridor continued to be the preferred location choice for plant openings by auto supplier companies in the 1990s. Correspondingly, the share of counties last occupied within the two southern states increased only slightly from 24 percent in the 1970s to 31 percent in the 1990s. Further, this figure

FIGURE 4

Auto corridor counties by last year of entry



Note: Interstate highways are shown only for the seven auto corridor states.
Sources: ELM Guide database, 1997; various state manufacturing directories, 1997.

underscores the continuing importance of highway transportation.

Model and results

The net migration evident in the auto corridor during the 1980s and 1990s is the product of a myriad of economic, demographic, locational, and historical factors. To estimate the combined influence of these factors, we need to perform a *multivariate analysis*. Here, we examine the impact of these background factors and the influence of the auto industry using *ordinary least squares regression*. We estimate a separate cross-sectional model for each of the two decades. The dependent variable in each model is the net migration during the decade (defined as population change net of natural increase) relative to the level of population at the beginning of the period. The analysis covers the 455 nonmetropolitan counties in the seven auto corridor states.

We group the independent variables into two major categories. The first represents economic, locational, and demographic variables recognized as important in previous work (Johnson, 1998; and Goetz and Rupasingha, 1999). We include measures of labor force structure, commuting, metropolitan adjacency, and whether the county is a retirement or recreational node (Beale and Johnson, 1998; and Cook and Mizer, 1994). Because there has been considerable regional variability in nonmetropolitan demographic trends recently, we include a dummy variable to differentiate the two southern states from the five midwestern states. Demographic change may also be influenced by the size of the local population; therefore, we include a county's population at the beginning of each period. Table 7 provides a detailed description of the variables included in the models.

We supplement these standard economic, locational, and demographic variables with a block of

TABLE 7

Variable key

Dependent variable	
Net migration	Population change minus natural increase relative to population at beginning of period.
Independent variables	
Control variables	
Metro adjacency	1 if nonmetropolitan county is adjacent to metropolitan county, 0 otherwise.
Recreational county	High proportion of spending and employment in recreational industries, large concentration of second homes, high per capita spending on hotels and motels, contextual data indicating presence of major tourist activity.
Retirement county	Net migration gain for those over the age of 60 by 15 percent or more between 1980 and 1990.
Percent employed in agriculture	Ratio of employment in agriculture to total employment at beginning of decade.
Percent employed in manufacturing	Ratio of employment in manufacturing to total employment at beginning of decade.
Percent work outside the county	Ratio of employees who had jobs outside the county of residence to total employment at beginning of decade.
Population	Population at beginning of period.
South	1 if county is in Kentucky or Tennessee, 0 otherwise.
Unemployment rate	Annual average rate at beginning of decade.
Auto variables	
Supplier base	Number of independent supplier plants at the beginning of decade.
Supplier addition	Number of independent supplier plants added during decade.
Major auto plant base	Number of assembly and captive supplier plants at beginning of decade.
Major auto plant addition	Number of assembly and captive supplier plants added during decade.
Contig. major auto plants base	Number of assembly and captive supplier plants in contiguous counties at beginning of decade.
Addition of contiguous major plants	Number of assembly and captive supplier plants added in contiguous counties during decade.

variables measuring the presence of the auto industry in a county. This characterization of the auto industry distinguishes between the assembly and parts plants owned by major foreign or domestic automakers (labeled "major") and independent supplier plants (labeled "supplier").[9] The independent supplier plants tend to be smaller, more numerous, and more widely distributed throughout the nonmetropolitan areas of the auto corridor. The company-owned plants are considerably larger and tend to be located in metropolitan areas (see table 6). For each of these two major plant types we measure the number of plants in operation at the beginning of the modeling period and the number of plants added during the decade. Finally, it is possible that the impact on migration of locating a plant spills over into surrounding counties. We model this so-called contiguity effect only for assembly and captive parts plants, as these plants employ substantial numbers of workers. We use variables measuring the number of major plants in contiguous counties at the beginning of the period as well as the number of new plants added during the period.[10]

The explanatory power of the estimated model for migration is similar in each period (see table 8 and the appendix for the estimated coefficients). It accounts for 37 percent of the variation in net migration between 1990 and 1997, compared with 43 percent between 1980 and 1990. There is also considerable consistency in the contribution of specific variables during both periods. Among the control variables, greater migration gains were likely in counties that were centers of recreation and retirement, had a higher share of commuters to neighboring counties, and were located in Kentucky or Tennessee. Other things being equal, counties with employment concentrations in agriculture and those with a larger population tended to gain less or lose more from migration than other counties. For each of these variables, results for both periods are statistically significant.

The block of six variables representing the auto industry provides a statistically significant improvement in explanatory power during the 1990s.[11] The incremental improvement during the 1980s does not quite reach statistical significance. The directional impact of the individual variables is also quite consistent for the two decades. The addition of assembly and captive supplier plants (major) in either the county of interest or a contiguous county has a positive impact on migration. This effect is statistically significant for the 1990s. In the immediate county it increased net migration by 7.68 percent. The effect on net migration spills into the contiguous counties, albeit at a reduced level (3.29 percent in the 1990s). The size of this spillover effect is similar in magnitude to the effect of being a retirement county.

In contrast, counties containing assembly and captive supplier plants at the beginning of a given decade were likely to be adversely affected with respect to migration, though the impact was statistically significant only for the 1980s. This may reflect the cutbacks experienced in the auto industry during the 1980s and early 1990s. A county containing such plants at the beginning of the 1980s experienced an additional net migration of –2.5 percent whereas the mean value for nonmetropolitan counties during that decade was –3.9 percent. That result suggests that during the 1980s the presence of auto plants worsened the negative migration experience of nonmetropolitan counties. Once again, this effect spills over into contiguous counties. For these counties we estimate that the presence of assembly and captive supplier plants

TABLE 8

Summary of results for nonmetropolitan counties

	1990s	1980s
Intercept	+	+
Control variables		
Metropolitan adjacency	+	+
Recreational county	+***	+**
Retirement county	+***	+***
Percent employed in agriculture	–**	–***
Percent employed in manufacturing	+*	–
Percent work outside the county	+***	+*
Population	–***	**
South	+***	+***
Unemployment rate	–***	+
Auto variables		
Supplier base	+	+
Supplier addition	–	+*
Major auto plant base	–	–*
Major auto plant addition	+***	+*
Contiguous major plants base	–***	–***
Contiguous major plants addition	+***	+
R-squared	0.37	0.43
Number of observations	455	455

*Indicates significance level of 90 percent; **indicates 95 percent; and ***indicates 99 percent.
Note: See table 7 for variable definitions.

TABLE 9

Results for nonmetropolitan counties

	1990s	1980s
Intercept	2.348 (1.26)	–1.88 (–1.06)
Control variables		
Metropolitan adjacency	0.854 (1.58)	0.615 (1.22)
Recreational county	3.321 (3.33)	2.06 (2.31)
Retirement county	10.970 (9.45)	13.590 (11.10)
Percent employed in agriculture	–0.145 (–2.07)	–0.315 (–6.48)
Percent employed in manufacturing	0.061 (1.83)	–0.040 (–1.06)
Percent work outside the county	0.107 (4.15)	0.058 (1.50)
Population	–0.00005 (–2.76)	–0.00003 (–2.34)
South	2.865 (4.13)	2.310 (4.17)
Unemployment rate	–0.257 (–2.55)	0.023 (0.28)
Auto variables		
Supplier base	0.051 (0.41)	0.191 (1.55)
Supplier addition	–0.002 (–0.006)	0.347 (1.85)
Major auto plant base	–0.971 (–0.70)	–2.470 (–1.74)
Major auto plant addition	7.683 (6.41)	2.560 (1.80)
Contiguous major plants base	–0.429 (–4.04)	–0.300 (–3.86)
Contiguous major plants addition	3.293 (4.34)	0.531 (1.00)
R-squared	0.37	0.43
Number of observations	455	455

Notes: See table 7 for variable definitions. Numbers in parentheses are t-stats. The error terms are White-corrected for heteroskedasticity.

at the beginning of the decade lowered net migration by –0.4 percent in the 1990s and –0.3 percent in the 1980s. The estimated effects of the presence and addition of independent supplier plants, which generally are much smaller plants, tend not to be statistically significant. However, for the 1980s, the decade that saw the largest number of independent supplier plants start up during the time period analyzed (see table 6), adding a supplier plant increases net migration by 0.3 percent.[12]

In order to address the effect of plant size more directly, we reestimate the model for the 1990s, distinguishing auto plants by their employment level. Consequently, we redefine all the auto industry variables to represent either large (1,000 employees or more) or small plants. The estimates we obtain are virtually identical to the ones reported in table 9, which suggests that locating a large plant in a nonmetropolitan county raises net inmigration into that county by 7.68 percent and by 3.29 percent in the surrounding nonmetropolitan counties.[13]

In sum, we find that accounting for the presence of auto plants adds to the explanatory power of a model of county-level net migration. Our results reproduce earlier findings for a fairly standard set of control variables. Furthermore, we find that adding a large plant to a nonmetropolitan county triggers a sizeable positive net migration response, both in the county where the plant locates and in the surrounding counties.

Conclusion

This article addresses possible linkages between the recent spatial shifts in the auto industry and demographic change at the county level, a question that had previously received very little attention. We perform the analysis for the seven states that represent the core of the U.S. auto industry. We use a standard set of control variables measuring economic, locational, and demographic characteristics together with a comprehensive set of data on the distribution of auto plants across space and time.

Consistent with previous empirical work, we find that the background variables widely used in demographic research account for a substantial proportion of the variation in county-level migration. However, adding variables measuring both presence and addition of two types of auto plants adds to the explanatory power of the model. As a group, the auto industry variables provide a modest incremental improvement in explanatory power for net migration. Most prominent among the industry variables is the addition of a large plant (that is, 1,000 employees or more) to a county. This has a significant positive influence on migration. This effect is evident both in the county that receives the plant and in those contiguous to it.

Our finding regarding the importance of auto industry variables has significant policy implications. It

suggests that development efforts aimed at retaining or attracting population will have greater immediate success if they focus on attracting larger plants. Furthermore, this result underscores the importance of cooperative efforts to obtain such plants, given that they positively affect population in a multicounty area. Future research will look more specifically at the effect on migration of the young adult population.[14]

APPENDIX

Means and standard deviations (455 nonmetropolitan counties)

	Mean	Standard deviation
Net migration 1990s	5.135	6.809
Net migration 1980s	–3.872	6.615
Control variables		
Metro adjacency	0.530	0.500
Recreational county	0.090	0.287
Retirement county	0.053	0.224
Percent employed in agriculture, 1990s	6.457	4.214
Percent employed in agriculture, 1980s	11.260	7.170
Percent employed in manufacturing, 1990s	25.570	9.729
Percent employed in manufacturing, 1980s	27.420	10.120
Percent work outside the county, 1990s	31.112	13.808
Percent work outside the county, 1980s	25.880	12.860
Population, 1990	26,602	19,014
Population, 1980	26,643	19,068
South	0.367	0.483
Unemployment rate, 1991	9.040	2.960
Unemployment rate, 1981	11.010	3.630
Auto variables		
Supplier base, 1990	1.295	2.169
Supplier addition, 1990s	0.165	0.515
Supplier base, 1980	0.822	1.526
Supplier addition, 1980s	0.473	1.108
Major auto plant base, 1990	0.029	0.191
Major auto plant addition, 1990s	0.007	0.105
Major auto plant base, 1980	0.020	0.168
Major auto plant addition, 1980s	0.009	0.093
Contiguous major plants base, 1990	0.532	1.923
Contiguous major plants addition, 1990s	0.059	0.279
Contiguous major plants base, 1980	0.413	1.792
Contiguous major plants addition, 1980s	0.119	0.419

Note: See table 7 for variable definitions.

NOTES

[1]The number of plant openings by Japanese auto parts suppliers in the U.S. peaked in the late 1980s (Klier, 1994).

[2]Except for Illinois, all the states in the auto corridor have a higher than average motor vehicle and equipment (Standard Industrial Classification 371) share of gross state product (GSP). The data are averaged over 1995, 1996, and 1997. The specific industry shares of GSP are: Illinois, 0.79 percent; Indiana, 4.91 percent; Kentucky, 5.27 percent; Michigan, 8.52 percent; Ohio, 3.66 percent; Tennessee, 2.74 percent; and Wisconsin, 1.46 percent. The U.S. average for that period is 1.09 percent (data from U.S. Bureau of Economic Analysis).

[3]Between 1970 and 1993, 43 formerly nonmetropolitan counties were redefined as metropolitan, and 13 formerly metropolitan counties were reclassified as nonmetropolitan.

[4]In all, 8.4 percent of the original database entries could not be confirmed by review of state directories nor could they be reached by phone. However, we are confident that the coverage afforded by the database is high. The employment estimates for Michigan assembly and supplier plants are only slightly below those reported by McAliden and Smith (1999) using ES 202 data.

[5]The demographic trends in the auto corridor during the past 30 years have been generally consistent with those in the nation. The only exception to this general consistency between population growth patterns in the auto corridor and the nation is that metropolitan areas of the auto corridor lost a significant amount of population during the 1970s and 1980s, whereas metropolitan areas in the U.S. as a whole generally gained population.

[6]Fourteen counties of the nonmetropolitan counties in the auto corridor are both recreational and retirement counties.

[7]It slightly overstates the concentration of independent supplier plants in Michigan by showing all plants, regardless of their age. If we were to present information on plants opened since 1980 only, Michigan's share would fall from 39 percent to 36 percent.

[8]Within a just-in-time production environment, inventories at assembly and supplier plants are being minimized, which puts a premium on being able to deliver parts on time to the assembly line. Consequently, the majority of parts shipments to assembly facilities is delivered by truck, whereas the final product is distributed across the country by a combination of truck and rail.

[9]We chose this categorization, which indirectly distinguishes plant size, because plant-level employment data are available only for 1997.

[10]In defining this variable, we take account of contiguous plants in metropolitan and nonmetropolitan counties.

[11]An F-test shows it to be significant at the 95 percent level.

[12]The difference in the estimated effect of adding a major plant and adding a supplier plant for the 1980s is approximately commensurate to the factor by which an average major plant is larger, in terms of employment, than an average supplier plant.

[13]That corresponds to an estimated net inmigration of 12.7 percent for the immediate county. The actual net migration rates for the two nonmetropolitan counties in which large plants opened during the 1990s, two Saturn facilities in Spring Hill, Tennessee, and one large independent supplier plant in central Michigan, are 22.1 percent and 6.1 percent, respectively.

[14]Data will not become available until after the release of the 2000 Census.

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