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Deriving Empirical Definitions of Spatial Labor Markets: The Roles of Competing versus Complementary Growth

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Versus Complementary Growth**

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I. Introduction

All fifty states have publicly sponsored economic development efforts designed to attract new firms to the state. In principle, each state competes with 49 others in attracting new jobs. Similarly, individual communities through Chambers of Commerce or local economic development agencies, attempt to attract new firms, sometimes competing with other communities in the same state. However, it is not clear that all economic gains in one community come at the expense of potential gains in other communities. In particular, if one town succeeds in attracting new jobs, municipalities within commuting distance may benefit rather than be harmed by the first community's good fortune.

This study defines the extent of a labor market using evidence of spillover benefits from wage growth or job growth in other counties. The study makes use of a simple utility model, explaining individual residence decisions as a response to factors affecting individual income. If economic growth elsewhere raises the individual's earning prospects relative to those in the present location, then the individual will move. On the other hand, if the individual can exploit the economic growth elsewhere by commuting, he will not need to move to profit from the expansion. Aggregating this individual-based model to the county level, we show that county population will rise whenever economic expansion occurs in the own county or in counties within commuting distance. On the other hand, economic growth outside the commuting range will lower local population growth.

The model is tested using county-level data from eight states in the Midwest over the period 1969-1994. All necessary data are available from electronic data files made

available by the Bureau of Economic Analysis. County population is explained by county wage growth, wage growth in adjacent and nonadjacent counties, and national wage growth. The specification is repeated using information on job growth and on wage bill growth (wages times jobs). Empirical estimates correct for possible simultaneous determination of local economic growth measures and local population.

The results are quite consistent, regardless of how economic growth is measured. Local county population responds positively to own-county economic growth, economic growth in the adjacent county, and even economic growth two counties away. The magnitude of the effect decreases as distance from the county increases. On the other hand, economic growth beyond two counties distance lowers population, presumably because change of residence is required if the local population is to benefit from distant economic growth. The pattern of results differs depending upon the size of the county. In particular, if economic growth is uniform across all counties in the Midwest, the least populous counties will lose population while the most populous counties will get larger.

These results suggest that the relevant labor market for a county includes communities within a two-county radius. Presumably, then, it is wasteful for economic development efforts to attempt to compete with other communities within this area. Instead, cooperative efforts to attract a business to the area would still insure at least partial benefit to all counties in the region, regardless of which county the firm selects.

II. A Model of Population Growth

Our approach to these questions uses a simple utility based model of individual locational decisions. The underlying assumption is that the individuals get utility from wages and job prospects. Consequently, they decide where to live based on a comparison of the relative economic benefits of living in alternative counties. If economic growth elsewhere raises an individual's earning prospects sufficiently relative to those in the present location, then the individual will move. On the other hand, if the individual can exploit the economic growth elsewhere by commuting, then the individual will not need to move to profit from the expansion. Aggregating this individual-based model to the county level, we show that county population will rise whenever economic expansion occurs in the own county or in counties within commuting distance. On the other hand, economic growth outside commuting range will lower local population growth.

At any given time t , an individual living in county 0 has three options regarding work and location: work in the local county receiving wage $W_{0,t}$ and incur no commuting cost; work in another county, k , and absorb commuting costs $C_{k,t}$ in exchange for receiving wages $W_{k,t}$; or move to a separate labor market, m , for wages $W_{m,t}$ and absorb moving costs $M_{m,t}$.

We define the indirect utility of an individual living in county 0 as a function of the average wage in county 0, and of the wage of counties within commuting distance net of commuting costs. This can be specified as $U_{0,t}(W_{0,t}, W_{k,t} - C_{k,t})$, where $W_{0,t}$ is the average wage per job in county 0 at time t , and $W_{k,t} - C_{k,t}$ is a vector of wages minus the commuting costs for counties within commuting distance, $k=1, \dots, K$. Similarly, for an individual living in county 0, the utility associated with residing in another county m outside commuting

distance can be expressed as $U_{m,t}(W_{m,t}, M_{m,t})$ where $W_{m,t}$ is the prevailing market wage, and $M_{m,t}$ is the cost of moving from county 0 to county m.

At time t, an individual will want to maximize utility by deciding where to locate based on a comparison of utilities across all counties, $U_{i,t}$, $i=0, \dots, N$. This decision is written as

$$(1) U = \text{Max} (U_{0,t}, U_{1,t}, \dots, U_{N,t})$$

where $U_{i,t}$ is the utility for county i, and N is the number of counties. Consequently, the utility of an individual in any county can be expressed as a function of all county wage levels and on the moving and commuting costs between counties,¹

$$(2) U = \text{Max} (U_{0,t}, U_{1,t}, \dots, U_{N,t}) = U(W_{0,t}, W_{1,t}, \dots, W_{N,t}, C_{1,t}, \dots, C_{N,t}, M_{1,t}, \dots, M_{N,t}).$$

Suppose an individual initially resides in county 0. Equation (2) implies that at any time t, an individual will live in county n if conditions change so that $\text{Max} (U_{0,t}, U_{1,t}, \dots, U_{N,t}) = U_{n,t}$.

Thus, $P_{j,t}$, the population level in county j at time t, can be expressed as a function of the utility levels across all counties, which are in turn a function of the wages, commuting and moving costs for all counties considered. In notation,

$$(3) P_{j,t} = G[U_{0,t}, \dots, U_{N,t}] = G[W_{0,t}, W_{1,t}, \dots, W_{N,t}, C_{1,t}, \dots, C_{N,t}, M_{1,t}, \dots, M_{N,t}]$$

To make (3) tractable empirically, we need to specify functional forms for G and $U_{j,t}$. Assuming a Cobb-Douglas form for $U_{j,t}$, the utility functions will be

$$(4) U_{j,t}[W_{0,t}, W_{1,t}, \dots, W_{N,t}, C_{1,t}, \dots, C_{N,t}, M_{1,t}, \dots, M_{N,t}] = \prod_{i=0}^N W_{i,t}^{\alpha_i} * M_{i,t}^{\beta_i} * C_{i,t}^{\delta_i};$$

¹ Later we will substitute local jobs and local income for local wages in our utility function. For the most part, our results are quite similar regardless of how the strength of the local labor markets is measured.

where α_i are the relative weights on wages, β_i are the relative weights on migration costs, and δ_i are the relative weights of commuting costs in the utility function. We assume that $G[\cdot]$ in equation (3) is proportional to the level of utility, so that

$$(5) P_{j,t} = \gamma U_{j,t}[W_{0,t}, W_{1,t}, \dots, W_{N,t}, C_{1,t}, \dots, C_{N,t}, M_{1,t}, \dots, M_N] = \gamma \prod_{i=0}^N W_{i,t}^{\alpha_i} * M_{i,t}^{\beta_i} * C_{i,t}^{\delta_i},$$

where γ is a constant of proportionality.

The values of α_i determine how the population responds to relative wages in the own county and elsewhere. The signs of α_i indicate whether wages in a county raise or lower utility in the own county relative to utility elsewhere. We expect wages in the own county will raise $U_{0,t}$, holding other county wages constant, so that $\alpha_0 > 0$. If wages in another county j raise utility in the own county, $\alpha_j > 0$. If wages in county j raise utility elsewhere relative to the own county, $\alpha_j < 0$. Therefore the signs on α_j for adjacent and non adjacent counties are relevant for understanding linkages between counties in terms of complementary versus competing growth effects. The only way W_j can increase $U_{0,t}$ relative to utility elsewhere is if workers living in the own county can commute to county j . Therefore, a positive value of α_j implies the existence of complementary growth between counties. In other words, counties 0 and j are in the same spatial labor market. A negative coefficient indicates the presence of competing growth between counties. We interpret a negative coefficient as an indication that workers in the own county would have to migrate in order to benefit from wages in county j .

Our interest is to examine the relationship between the growth rate of a county's population and the economic growth rate of its surrounding area. Taking natural

logarithms of (5) we get

$$\ln P_{j,t} = \ln \gamma + \alpha_0 \ln W_{0,t} + \alpha_1 \ln W_{1,t} + \dots + \alpha_N \ln W_{N,t} + [\beta_1 \ln M_{1,t} + \dots + \beta_N \ln M_{N,t} + \delta_1 \ln C_{1,t} + \dots + \delta_N \ln C_{N,t}].$$

To get a population growth rate, we take the difference between time t and $t+k$, so that

$$(6) \quad \ln[P_{j,t+k}/P_{j,t}] = \ln \gamma + \sum_{i=0}^N \alpha_i \ln [W_{i,t+k}/W_{i,t}] + \sum_{i=0}^N \beta_i \ln [M_{i,t+k}/M_{i,t}] + \sum_{i=0}^N \delta_i \ln [C_{i,t+k}/C_{i,t}]$$

At any point in time, migration costs and commuting costs will differ across counties.

However, the rate of change of these costs will primarily reflect changes in transportation equipment and fuel costs that are common across counties. Therefore, we assume

$$\ln[M_{i,t+k}/M_{i,t}] = \alpha_M + e_{j,t}^M \quad \text{and} \quad \ln[C_{i,t+k}/C_{i,t}] = \alpha_C + e_{j,t}^C.$$

We assume that the idiosyncratic commuting and migration costs are uncorrelated with the average wages. Then,

$$(7) \quad \ln[P_{j,t+k}/P_{j,t}] = \alpha + \alpha_0 \ln[W_{0,t+k}/W_{0,t}] + \alpha_1 \ln[W_{1,t+k}/W_{1,t}] + \dots + \alpha_N \ln[W_{N,t+k}/W_{N,t}] + e_{j,t}$$

where $\alpha = (\alpha_M + \alpha_C)N$ is a constant and $e_{j,t} = e_{j,t}^M + e_{j,t}^C$ is a random error term.

Empirical Strategies

The equation we estimate is

$$(8) \quad \ln[P_{j,t+k}/P_{j,t}] = \alpha + \alpha_0 \ln[W_{0,t+k}/W_{0,t}] + \alpha_1 \ln[W_{1,t+k}/W_{1,t}] + \alpha_2 \ln[W_{2,t+k}/W_{2,t}] \\ + \alpha_N \ln[W_{N,t+k}/W_{N,t}] + e_{j,t}$$

where the values $\ln[P_{j,t+k}/P_{j,t}]$ and $\ln[W_{0,t+k}/W_{0,t}]$ are observed for county j , $\ln[W_{1,t+k}/W_{1,t}]$ is for an adjacent county (one county away from j), $\ln[W_{2,t+k}/W_{2,t}]$ is for a non-adjacent county (two counties away from j), and $\ln[W_{N,t+k}/W_{N,t}]$ aggregates the effect of the rest of the states into an observation on the national average.

A cause for concern is the likely simultaneity between population growth and wage growth in the same county. Many papers document the existence of simultaneity, using a variety of instruments to identify the causal relationship (Greenwood, 1986; Clark, 1996).

We selected instruments based on a local labor market model which assumes lagged adjustments to equilibrium wages and employment. These adjustments are illustrated in Figure 1. Demand and supply are defined in per population terms. The proportion of the population supplying labor is upward sloping in the wage, while the proportion firms want to hire is a downward sloping function of the wage. It is possible that per capita labor demand varies with population if there are agglomeration economies, so we index demand by population. The employment rate is defined as E_t/P_t where E_t is the employment level at time t , and P_t is the population. The employment rate varies between zero and one. Given prevailing demand and supply conditions for labor, E_t/P_t reaches a maximum possible value, E_t^e/P_t , when the wage is at equilibrium, W_t^e . Any departure from equilibrium will result in a lower value for E_t/P_t , regardless of whether the wage is above or below equilibrium.

Suppose that the employment rate is given by E_{1t}/P_t in Figure 1. If the wage is W_t^0 so that we have excess supply of labor, there will be downward pressure on future wages. If the wage is W_t^1 there is excess demand for labor so that wages will rise in the future. As a consequence, holding constant E_t/P_t , the higher is W_t , the lower will be W_{t+1} if the market tends toward equilibrium. Because low levels of E_t/P_t imply a departure from equilibrium employment regardless of whether the wage is above or below equilibrium, we cannot predict the effect of E_t/P_t on future wages. On the other hand, we know that low E_t/P_t implies that employment will rise as the market adjusts toward equilibrium. Therefore, we would expect low values of E_t/P_t to signal higher values of E_{t+1}/P_{t+1} . As is clear from Figure 1, there is no unique relationship between W_t and E_{t+1}/P_{t+1} . Both wages

that are above equilibrium (W_t^0) and wages that are below equilibrium (W_t^1) would imply an increase in future employment as the labor market adjusts toward equilibrium.

This simple sticky wage model of local labor markets suggests that one can forecast future wage and employment growth in a county using information on wages and employment rates in the current period. Implicitly, this formulation assumes that wages are in real terms, so we should add a control for price differences in living costs in the base period. We settled on the following empirical formulation.

$$(9) \ln[W_{0,t+k}/W_{0,t}] = a + a_1 \ln[W_{0,t}] + a_2 \ln[E_t/P_t] + a_3 \ln[P_t] + a_4 \ln[P_t]^2 + a_5 \text{URBAN} + e_t$$

where $\ln[W_{0,t}]$ is the log of the average wage at time t , and $\ln[E_t/P_t]$ is the log of the employment rate, calculated as the number employed in the county divided by population. $\ln[P_t]$ and $\ln[P_t]^2$ are the log of the population level and its square, included to fix the level of demand per capita in the base period. URBAN is an urban dummy, equal to one if the county was an urban center, or adjacent to an urban center in 1969. A county was considered an urban center if it had a population above 50,000 in 1969. This is included to help control for differences in living costs between urban and rural markets. We expect the coefficient on $\ln[W_{0,t}]$ to be negative. The coefficient on URBAN should be positive if wages in urban areas are higher in part because of higher living costs.² The other coefficients cannot be signed a priori.

² In equation (9), wages are deflated by the consumer price index. However, relative cost of living may vary across urban and rural markets. Let P_U be the relative cost of living in an urban market when living costs in a rural market are normalized to one. We expect $P_U > 1$ if it is more expensive to live in the urban market. Then for a given wage level $W_{0,t}$, the base real wage effect on wage growth will be $a_1 \ln(W_{0,t}/P_U) = a_1 \ln(W_{0,t}) - a_1 \ln(P_U)$ for the urban market and $a_1 \ln(W_{0,t})$ for a rural market. The coefficient on the urban dummy variable will be $-a_1 \ln(P_U)$. Theory suggests $a_1 < 0$, so if $P_U > 1$, $-a_1 \ln(P_U) > 0$.

To determine whether county population growth is affected by the wage growth outside its borders, we need to measure wage growth in the surrounding counties. From each group of adjacent and non-adjacent counties, we identified the county with the highest population in 1969, the first year for which we had data. It was assumed that these largest counties would have the most significant impact on utility in the own county because of better information on jobs and wages in the larger labor markets. Thus, wage growth one county away is measured by the wage growth in the largest adjacent county and wage growth two counties away is measured by wage growth in the largest county two counties away.

We estimated equations (8) and (9) simultaneously, using three stage least squares. Our sample includes all counties regardless of initial size. It is possible that the response of population growth to own wage growth or wage growth elsewhere differs between large and small counties. Therefore, we also estimate the model over subsamples of counties defined by the lowest quartile, the middle quartiles and the upper quartile of population in 1969.

III. Data

The data used are from the Bureau of Economic Analysis, from the years 1969 to 1994. The states included in the sample are Iowa, Kansas, South Dakota, Nebraska, Illinois, Wisconsin, Minnesota, and Missouri. These states were chosen because a significant portion of each state was rural, and a significant proportion of the population resided in nonrural, nonmetropolitan locations. This assures us of considerable variation in county population. In addition, counties were of comparable size across states and were arranged in a similar grid pattern. Comparable size makes it more sensible to assume

equal growth in migration and commuting costs. Comparable grid patterns make it more sensible to assume equal population supply responses to economic growth one or two counties away. There were a total of 737 counties, of which 277 were determined as urban by our earlier criteria.

We divide the time period into five subperiods of five years each. The base periods were 1969, 1974, 1979, 1984, and 1989. The growth rates for population and average wage per job were measured over five year intervals: 69-74, 74-79, 79-84, 84-89, and 89-94. This yielded five time periods for every state, bringing the total number of observations to 3685. A five year period should provide a sufficiently long time to capture the long run population response to changes in local and surrounding labor markets. It also sidesteps potential complications due to short term common cyclical shocks which could exaggerate the positive correlation between local wages and employment.³

Population is defined as the total number of people living in the county. Wage per job is the wage and salary earnings per person working in the county. It is important to emphasize the distinction between the measures of population and wage. County population includes those living in the county, but not necessarily working in the county. Wage and employment data are from all people working in the county including those who commute to the county but live elsewhere, and excluding those who live in the county but work elsewhere. In this way, we are able to divorce labor market variables from population responses.

³ The average recession lasted less than one year over this period, so five year growth rates should not reflect short-term macroeconomic fluctuations.

IV. Population Growth from Spatially Differentiated Wage Growth

The results of the system estimation of equation (8) and (9) are presented in Table 1.⁴ The system explains only 5 percent of the variation in population and wage growth. The coefficients in the population growth equation are interpretable alternatively as elasticities of utility with respect to wage levels, or as elasticities of population growth with respect to wage growth in each area. A 10 percent increase in the local county wage growth results in a 5.9 percent increase in population growth. As one would expect, increased wage growth in a county raises the utility from residence in that county and attracts migrants. The coefficients α_1 and α_2 indicate how wage growth rates in the adjacent and non adjacent counties affect population growth in the own county. The positive α_1 indicates complementary growth effects between adjacent counties, but the coefficient is very small and is not precisely estimated. Wage growth in the adjacent county raises home county utility by only a fraction of the home county wage effect. In contrast, α_2 is negative and statistically significant. Taken literally, 10 percent wage growth two counties away lowers utility in the home county by 1.2 percent. These results suggest that the relevant county labor market as defined by population responses to spatially differentiated wage growth includes the home county and perhaps the adjacent counties. Wage growth outside that range lowers home county population, consistent

⁴ Estimates that do not correct for simultaneity between local wages and local population growth yielded similar qualitative results but exaggerated the effect of local wages on local population growth.

with the presumption that wage growth outside the local labor market raises utility elsewhere relative to home county utility, and thus causes outmigration.⁵

Despite the weak fit, the results from the instrumenting equation are consistent with the local labor market model outlined above. As required by the theory, holding the employment rate constant, higher wage levels cause wages to decrease in subsequent years. The coefficient on the URBAN dummy variable is positive, consistent with the impact of presumed higher urban living costs on wage growth.

When the sample is broken down by size of county population, we find that the size of the local labor market varies with population size. For the smaller counties, only local wage growth appears to raise population growth. For the largest counties, wage growth in the adjacent county also causes home county population to increase. Home county wage growth causes relatively inelastic population response in the smallest counties, but the population elasticity with respect to own county wages increases as county size increases. At the same time, wage growth outside the county has the greatest negative effect on the smallest counties.⁶

Common wage shocks across all markets might be expected to leave local population unchanged. However, if demand for local amenities varies with income, it is possible that wage changes would not be neutral. Consequently, equiproportional changes across all areas may cause the population to grow, decline or remain unchanged. The impact of such an equiproportional wage shock is the sum of the population elasticities, $\alpha_0 + \alpha_1 + \alpha_2 + \alpha_N$. The

⁵ We also estimated the model adding wage growth for the state, purged of the effects of the own, adjacent and nonadjacent counties. The coefficient on this variable was also negative but very small and insignificant.

⁶ The positive effect of national wage growth on population in the largest counties is a puzzle that is repeated when we examine the effect of external job growth on home county population growth.

summed effects are presented in Table 1 as the test of wage neutrality. In each case, we reject the null hypothesis that uniform wage growth has no effect on the population growth. Overall, uniform wage increases across all regions raise population in these states. However, the positive effect is limited to the counties in the middle and upper-size quartiles. The smallest counties get even smaller as wages rise in all markets.

These apparent differences in population elasticities between counties of different size could be due to the imprecision of the estimates for the smallest counties. To test this we imposed the restriction of equality of coefficients on wage growth across small, middle and large counties. This amounts to imposing equal values of α_0 , α_1 , α_2 , and α_N across the three subsamples, a total of eight restrictions on parameters. This test of structural equivalence leads to rejection of the null hypothesis of equal population growth responses to wage growth across counties of different size.

V. Alternative Measures of Economic Growth

Having investigated the relationship between population growth and wage growth, we consider alternative measures of economic growth that may also raise home county utility. We employ separately the number of jobs and total labor income earned in a county as variables that enter into the utility function. As before, we use a model linking population growth to job growth, and income growth. Jobs are measured as the number of wage and salary jobs in the county. Income is measured as the total wage and salary earnings for the people working in the county.

Population Growth from Spatially Differentiated Job Growth

The results of the joint estimation of equations (8) and (9) using job growth as the explanatory variable are presented in Table 2. The model explains 18 percent of the

variation in population and job growth. The coefficients represent elasticities of population growth to job growth in different areas. The results are puzzling, in that job growth is complementary with local population growth, regardless of the location of job growth.⁷ Population growth does respond most strongly to job growth in the own county. A 10 percent increase in local county jobs raises population by 4.4 percent. Although some of the job growth is accommodated by people already in the county or within commuting distance, nearly half of the job growth is filled by migrant job seekers from other counties. Job growth in adjacent counties also benefits the home county. The elasticity is about one fourth the size of the home county wage growth effect. Complementary growth effects extend to non-adjacent counties and the national level as well. The marginal utility of external county job growth declines with distance, as the elasticities with respect to non-adjacent and national job growth are roughly one-eighth of the home county effect. While the spillover benefits of more distant job growth are very small (a ten percent change in nonadjacent or national job growth raises local population by less than one percent in five years) the literal interpretation is that the relevant labor market includes adjacent and non-adjacent counties as well as the national labor market.

The local labor market model once again performs as expected in generating predictions of job growth. The model predicted that, holding wages fixed, higher employment rates in the base period would lead to slower future job growth. This prediction holds in the data. No other predictions come from the theory except that the sign on the base period wage should be opposite that on the urban dummy variable. That

⁷ Job growth at the state level does decrease local population, so these results are sensitive to specification.

expectation is also satisfied in the data. All in all, the instrumenting equations in Tables 1 and 2 are quite consistent with the simple sticky-wage model of local labor markets.

When we break the sample down by population size, the results for the market counties look more reasonable. The pattern of growth complementarities suggest that adjacent and nonadjacent counties raise local population, but that job growth outside that area lowers local population. Results for the larger counties are more similar to those of the full sample, with no clear geographic delimitation on the size of the local labor market.⁸

As before, we test for the structural equivalence of relationships between counties and find that there are significant differences in the elasticities of job growth between counties of different sizes. The test of neutrality indicates that equiproportional growth has a small positive and imprecisely estimated effect on the smallest counties. The population response to equiproportional job growth is much larger in the more populous counties.

Population Growth from Spatially Differentiated Income Growth

The results of the system estimation of equations (8) and (9) using real aggregate county income growth are presented in Table 3. Real income, $I_{0,t} = W_{0,t} * J_{0,t}$ is the product of the average wage and number of jobs in a county. Inserting real aggregate income in place of real wages into the specification of equation (8) is equivalent to the assumption that W_{0t} and J_{0t} have the same population elasticity α_0 . The model explains 24 percent of the variation in population and aggregate income growth. A 10 percent

⁸ State job growth lowered population in the larger counties, suggesting that the limits to the local labor market might be at or beyond the nonadjacent county.

increase in local county income increases population by 3.3 percent. The magnitude of the effect decreases with distance, but remains positive for counties within a two county radius.

Estimating across subsets, we find patterns similar to the ones observed over the entire sample. For all three size groups, population responds positively to its own aggregate income growth, and to aggregate income growth in adjacent and nonadjacent counties. Beyond the two county radius, income growth competes with local population growth. Local income growth is least effective in raising population in the smallest counties, while national growth has the largest negative effect on the smallest counties. Consequently, income growth is not neutral across counties. Common wage shocks across all counties lower population in the smallest counties and raise population elsewhere.

VI Conclusion

This paper uses spatially differentiated economic growth measures to determine the relationship between counties in terms of complementary or competing growth. The results strongly support the conclusion that there are complementary growth effects between adjacent counties. The implied extent of the local labor market is sensitive to specification and county size. However, the best performing model involving the use of aggregate labor income as the measure of growth in the labor market yields very consistent results. The benefits of aggregate income growth in a county will spillover to adjacent aggregate income and non-adjacent counties (two counties away). These results imply that the local labor market includes the home county and counties within a two county radius. Given the generally uniform structure and size of the counties in our study,

this result is consistent with studies that define the local labor market by a commuting time of up to an hour one way.⁹

We find that the largest counties have a structural advantage in attracting migration when they experience economic growth. When economic growth occurs nationally, the outmigration rate is lowest for these counties. The smallest counties benefit less from their own growth, and lose more from growth occurring elsewhere. When economic growth occurs in all areas, the smallest counties shrink while the middle and largest counties grow larger.

These results suggest that economic development strategies should be regionally based. By coordinating their efforts, counties can take advantage of the spillover benefits that exist between counties. In formulating policy for the smallest counties, it appears that jobs are as important or more important than wages in stimulating population growth. Therefore, it may be counterproductive to concentrate on creation of high wage jobs as opposed to policies which encourage job growth more generally when designing development policies for rural counties.

⁹ See So, Orazem, and Otto (1998).

Table 1: Regressions of Population Growth on Spatially Differentiated Wage Growth

Variables	Estimated Coefficients and t-Ratios			
	Entire Sample	Lower Quartile	Middle Quartiles	Upper Quartile
$\alpha_0: \ln[W_{0,t+5}/W_{0,t}]$	0.588302* ¹⁰ (4.069)	0.269549 (1.898)	0.555513* (2.753)	1.042711 (1.91)
$\alpha_1: \ln[W_{1,t+5}/W_{1,t}]$	0.016484 (1.027)	-0.027698 (-0.857)	0.009901 (0.466)	0.08388* (2.943)
$\alpha_2: \ln[W_{2,t+5}/W_{2,t}]$	-0.124321* (-7.425)	-0.047876 (-1.2372)	-0.139034* (-6.396)	-0.18881* (-6.283)
$\alpha_N: \ln[W_{N,t+5}/W_{N,t}]$	-0.132911* (-3.002)	-0.6499* (-7.205)	-0.254329* (-4.369)	0.607358* (7.69)
$a_1: \ln[P_t]$	0.022344* (8.784)	0.010431 (0.735)	-0.093226* (-1.965)	0.032015* (2.996)
$a_2: \ln[P_t]^2$	-0.001468* (-3.875)	0.000471 (0.075)	0.022253* (2.554)	-0.002545* (-2.336)
$a_3: \ln[E_t/P_t]$	-0.034534* (-8.122)	-0.047699* (-4.514)	-0.033187* (-5.907)	-0.040519* (-6.781)
$a_4: \ln[W_t]$	-0.027391* (-5.084)	-0.024557 (-1.524)	-0.032688* (-4.226)	-0.027993* (-3.789)
$a_5: \text{URBAN}$	0.009003* (4.801)	0.00528 (0.543)	0.008501* (3.004)	0.00546* (2.00)
System R-Square	0.0532	0.0451	0.0501	0.0795
<u>Test of Structural Equivalence</u>	98.6949*			
<u>Test of Neutrality</u>	3.6342	6.0632*	0.4737	3.963
Sum of Coefficients	0.347554	-0.455925	0.172051	1.545139

¹⁰ Significant at the .05 level.

Table 2: Regressions of Population Growth on Spatially Differentiated Job Growth

Variables	Estimated Coefficients and t-Ratios			
	Entire Sample	Lower Quartile	Middle Quartiles	Upper Quartile
$\alpha_0: \ln[J_{0,t+5}/J_{0,t}]$	0.440613* (18.536)	0.16536* (3.894)	0.346879* (9.513)	0.51313* (11.592)
$\alpha_1: \ln[J_{1,t+5}/J_{1,t}]$	0.128651* (13.254)	0.096548* (4.851)	0.130837* (9.521)	0.075348* (4.622)
$\alpha_2: \ln[J_{2,t+5}/J_{2,t}]$	0.065624* (6.405)	0.071654* (3.505)	0.068235* (4.738)	-0.035902* (-2.005)
$\alpha_N: \ln[J_{N,t+5}/J_{N,t}]$	0.087189* (4.009)	-0.236076* (-5.053)	0.084289* (2.795)	0.384734* (10.379)
$a_1: \ln[P_t]$	0.064769* (13.546)	0.001145 (0.056)	0.036079 (0.401)	0.147043* (6.339)
$a_2: \ln[P_t]^2$	-0.00421* (-6.031)	0.012271 (1.347)	0.008911 (0.539)	-0.012344* (-5.491)
$a_3: \ln[E_t/P_t]$	-0.101399* (-14.772)	-0.142226* (-9.634)	-0.1103* (-10.934)	-0.157873* (-11.188)
$a_4: \ln[W_t]$	-0.039057* (-4.251)	0.018948 (0.0815)	-0.061769* (-4.434)	-0.078366* (-5.297)
$a_5: \text{URBAN}$	0.009456* (2.334)	-0.016934 (-1.202)	0.00245 (0.464)	0.008924 (1.303)
System R-Square	0.1774	0.0837	0.1455	0.2402
<u>Test of Structural Equivalence</u>	74.4692*			
<u>Test of Neutrality</u>	434.978*	2.6787	174.1439*	213.1258*
Sum of Coefficients	0.722077	0.097486	0.63024	0.93731

Table 3: Regressions of Population Growth on Spatially Differentiated Income Growth

Variables	Estimated Coefficients and t-Ratios			
	Entire Sample	Lower Quartile	Middle Quartiles	Upper Quartile
$\alpha_0: \ln[I_{0,t+5}/I_{0,t}]$	0.325776* (14.475)	0.131394* (3.955)	0.259904* (7.802)	0.442114* (9.017)
$\alpha_2: \ln[I_{1,t+5}/I_{1,t}]$	0.170298* (23.597)	0.066693* (4.526)	0.167671* (17.091)	0.224918* (17.96)
$\alpha_3: \ln[I_{2,t+5}/I_{2,t}]$	0.122477* (16.01)	0.061012* (3.962)	0.132102* (12.513)	0.090954* (6.921)
$\alpha_N: \ln[I_{N,t+5}/I_{N,t}]$	-0.289337* (-14.119)	-0.373977* (-9.061)	-0.331947* (-11.745)	-0.127721* (-3.59)
$a_1: \ln[P_t]$	0.082703* (13.804)	0.012904 (0.45)	0.009798 (0.089)	0.0176015* (6.728)
$a_2: \ln[P_t]^2$	-0.005744* (-6.669)	0.011763 (0.924)	0.017753 (0.873)	-0.015366* (-6.104)
$a_3: \ln[E_t/P_t]$	-0.120477* (-13.142)	-0.185892* (-8.962)	-0.13307* (-10.002)	-0.176032* (-9.505)
$a_4: \ln[W_t]$	-0.048594* (-4.232)	-0.004004 (-0.123)	-0.072424* (-4.131)	-0.088195* (-4.953)
$a_5: \text{URBAN}$	0.014334* (2.873)	-0.011942 (-0.607)	0.007799 (1.159)	0.004706 (0.615)
System R-Square	0.212	0.1144	0.1913	0.2539
<u>Test of Structural Equivalence</u>	136.9217*			
<u>Test of Neutrality</u>	91.2987*	4.8488	23.4221*	64.895*
Sum of Coefficients	0.329214	-0.114878	0.22773	0.630265

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