Rural Population Growth, 1950-1990: The Roles of Human Capital, Industry Structure and Government Policy

Tzu-Ling Huang[a]
Peter F. Orazem[b]

January 1997

[a]Associate Professor of Economics, Ming Chuan University.

[b]Professor of Economics, Iowa State University.

This research benefitted from useful comments from Willis Goudy, Wallace Huffman, Peter Mattila, and Dan Otto. Philip Gassman and Mark Imerman helped us acquire the data. Donna Otto prepared the manuscript.

Journal Paper No. J-17205 of the Iowa Agriculture and Home Economics Experiment Station, Project No. 3450, and supported by Hatch Act and State of Iowa Funds.

Abstract

Census data on 306 midwestern and southern rural counties from 1950 to 1990 reveal large variation in population growth rates that cannot be explained by state or national level variables. A human capital investment model of migration is applied to data on changes in county working-age populations. The model's predictions are borne out by the empirical work. Results show that populations grow more rapidly in counties that have diversified employment opportunities, either in the county or in a nearby city. Counties having more highly educated populations grew more slowly, with this "brain drain" effect particularly concentrated in farm population declines. The farm population grows faster (or declines more slowly) in counties with relatively high farm income, and nonfarm populations grow faster in counties with relatively high nonfarm income. However, there is no evidence of positive spillover income effects across the farm and nonfarm sectors. Higher farm incomes lead to slower nonfarm population growth. County government fiscal policies have no net effect on population growth: any positive effect from services are negated by the negative effect of taxes or debt used to finance the services.

Rural Population Growth, 1950-1990: The Roles of Human Capital, Industry Structure and Government Policy

Rural population in the United States increased 53 percent between 1900 and 1990. This increase is concentrated in the nonfarm rural sector where population has grown to three times its turn-of-the-century level. Nevertheless, there seems to be concern among some policy-makers, writers, and economic development experts that rural areas are threatened by population declines which will gradually erode the ability of communities to provide public services necessary for their citizens. Eventually, the fear is that these communities will become too small to be self-sustaining and will disappear.

One might ask why these concerns exist in the face of slowing rising rural populations. One reason is that the overall rural population increase masks a huge migration of labor off the farm. The rural farm population has fallen to one-tenth its 1900 level. If a strong farm economy is necessary to sustain rural communities, then the farm population decline is a threat to the viability of rural communities. A second reason is the substantial variation in population growth rates across counties, so that some counties have shrunk substantially, even as others have grown.

The outflow of labor from agriculture has been widely studied,[1] but agricultural economists have usually looked at the issue without considering the overall rural labor market. This may be problematic since the nonfarm rural sector is a source of labor inputs to the farm sector. More importantly, off-farm income of farm households has been sizable since the 1960s, and in some years it has been larger than farm income.[2] The availability of off-farm job opportunities may depend on the stability or growth of rural communities. The size of these communities may also affect the availability of transportation services, farm input dealerships, and retail and service firms which affect the profitability of the farm sector.

This study examines the underlying causes of growth and decline in rural county populations over the 1950-1990 period. The analysis is conducted for the rural population as a whole, and also separately for the farm and nonfarm populations. Questions addressed include:

- How does average rural income affect rural population growth?
- Is there evidence of “brain drain” from rural counties? In other words, do rural counties with more highly educated populations grow more slowly than less educated rural counties?
- What is the role of proximity to a major city in rural population growth?
- Do counties grow faster if they have a narrowly specialized industrial base, or is a more diversified local economy more conducive to growth?
- Are local government services an inducement for increased rural populations? Are any positive effects counteracted by the need to finance these services through local taxes and/or debt?
- Are younger populations more sensitive to these factors than older populations?
- Are farm populations more sensitive to these factors than nonfarm populations?
- How do farm incomes affect nonfarm population growth? How do nonfarm incomes affect farm population growth?

Since Sjaastad’s (1962) pioneering work, economists have had a very successful model of migration behavior, based on the human capital investment approach. Nevertheless, agricultural economists have studied rural population changes only infrequently, whereas the issue represents a major focus of research in rural sociology.[3]

The study is conducted using Census data on a sample of 306 Southern and Midwestern counties which were designated as rural in 1950. The factors that best explain differences in rural county population growth rates are, in order of importance, the level of employment diversification, average rural income, average education level, and distance to a major city. The analysis shows that, other things equal, counties with higher average incomes grow faster. However, counties with more highly educated populations grow more slowly, with the "brain drain" effect particularly pronounced in the farm population. Rural counties benefit from proximity to an urban labor market and from a more diversified local economy. Younger populations are more sensitive to these factors than are populations more generally.

Local government fiscal policies have no effect on population growth — whatever positive effects there may be from locally provided government services are counteracted by the negative effect of the taxes needed to finance those services. Farm population grew more rapidly (or contracted more slowly) in counties with higher average farm incomes. Similarly, nonfarm populations grew more rapidly in counties with higher average nonfarm incomes. However, higher nonfarm incomes had no significant effect on farm populations, while higher farm incomes led to declining nonfarm populations. These last results suggest that nonfarm population growth does not depend on a strong farm economy, nor does farm population growth require a strong nonfarm economy.

The discussion opens with a review of modelling strategies. Next, we present descriptions of empirical issues and the data. The paper closes with a review of results and simulation exercises which support the conclusions outlined above.

I. Model

This section presents a model of locational preference similar to that of Barkley (1990). A

$$I^R\left(Y_t^R, C_t^R, P_t^R, Z_t^R \right)$$

representative individual's expected indirect utility in a rural location (I^R) :

where Y_t^R is the individual's time t expected rural income, C_t^R is job search and commuting costs, P_t^R is the rural cost of living; and Z_t^R is a vector of rural amenities and disamenities.

The individual faces an expected indirect utility function in an urban location (I^U) as well.

$$I^U\left(Y_t^U, C_t^U, P_t^U, Z_t^U \right)$$

The form for the urban area is

where the variables are the urban equivalents of those in (1).

The expected return from residing in R relative to U at time t is $I_t^R - I_t^U$. To simplify, assume intertemporal independence so that over a lifetime of length T, the discounted sum of

$$\Pi^R = \sum_{t=0}^{T} \left(I_t^R - I_t^U \right) \;/\; (1 + r)^t$$

these differences is

Assume the cost (pecuniary and nonpecuniary) of leaving R for U is concentrated in period 0 and represented by d^U. If Π^R is positive, or if it is negative but $\_\Pi^R\_ < d^U$, then the individual will prefer to remain in R. Otherwise, the individual prefers to move to U. In a population of size M_t^R, M_{t+1}^{RR} meet the requirement that $[\,(\Pi^R) > 0 \_ (\,\_\Pi^R\_ < d^U)\,]$ and remain in

R. The rest, M^{RU}_{t+1}, meet the requirement that $[\,(\Pi^R < 0)\ \_\ (\_\Pi^R\ \_ > d^U)\,]$ and move to U.[4] The

$$M^R_t = M^{RR}_{t+1} + M^{RU}_{t+1} + d^R_{t+1}$$

accounting identity for the rural population in period t and their state in t+1 is

where d^R_{t+1} are deaths that occur between time t and time t+1. A symmetric decision process

would set the criteria for moving into R from U. M^{UR}_{t+1} is the number of urban residents for whom

$[\,(\Pi^U < 0)\ \_\ (\_\Pi^U\ \_ > d^R)\,]$. Births can also occur over time, so the rural population at time t+1

$$M^R_{t+1} = M^{RR}_{t+1} + M^{UR}_{t+1} + b^R_{t+1}$$

will be

where b^R_{t+1} are births that occur between t and t+1. The proportional population change in the

$$\frac{M^R_{t+1} - M^R_t}{M^R_t} = \frac{\left(M^{UR}_{t+1} - M^{RU}_{t+1}\right) + b^R_{t+1} - d^R_{t+1}}{M^R_t} = \frac{N^R_{t+1}}{M^R_t} + e^R_{t+1}$$

rural area from t to t+1 is

where N^R_{t+1} is net inmigration into R and $e^R_{t+1} = \frac{b^R_{t+1} - d^R_{t+1}}{M^R_t}$ is the proportional change in population due to births and deaths between t and t+1. The net migration component relates to the model directly, while births and deaths will be treated as a source of random error.

II. **Empirical Formulation**

$$\ln (M^R_{t+1} / M^R_t) = b_0 + \ln\left(\frac{Y^R_t}{Y^U_t}\right) b_1 + \ln\left(\frac{C^R_t}{C^U_t}\right) b_2 + \ln\left(\frac{P^R_t}{P^U_t}\right) b_3$$

$$+ \ln\left(\frac{Z^R_t}{Z^U_t}\right) b_4 + \ln (d^U / d^R) \; b_5 + -^{R}_{t+1}$$

Equations (3) and (6) suggest that population changes should be a function of $Y^R_t, Y^U_t, C^R_t, C^U_t, P^R_t, P^U_t, Z^R_t, Z^U_t, d^R$, and d^U. Rural residents are assumed to know the rural incomes and amenities, but they must forecast earnings and amenities in the urban market. We approximate the population change in a given rural county by the following equationwhere $\ln (M^R_{t+1} / M^R_t) \approx \frac{N^R_{t+1}}{M^R_t} + e^R_{t+1}$ in (6)[5] and $-^{R}_{t+1}$ is a random error term. The term $\ln (d^U/d^R)$ is the log ratio of psychic and pecuniary costs of moving to an urban area relative to the costs of moving to a rural area. Because the pecuniary costs of moving from R to U should equal the cost of moving from U to R, the magnitude of d^U/d^R will reflect mainly the relative psychic costs to new urban and rural arrivals. Rural populations will grow faster when d^U is high and d^R is low.

To operationalize (7), we need to derive measures of expected incomes. Rural and urban incomes are assumed to depend upon human capital, H_t, and local labor market conditions, X_t.

$$\ln Y^R_t = g^R_0 + H^R_t \; g^R_1 + X^R_t \; g^R_2 + e^R_t$$

$$\ln Y^U_t = g^U_0 + H^U_t \; g^U_1 + X^U_t \; g^U_2 + e^U_t$$

Equations explaining variation in county income are of the form where e_t^R and e_t^U are error terms with mean zero. The error terms represent location-specific returns that are uncorrelated with observed labor market and human capital variables. These errors are known by migrants, but are unobservable to the econometrician.

A rural resident can predict his earnings in an urban area by applying his human capital

$$\ln Y_t^{RU} = g_0^U + H_t^R\ g_1^U + X_t^U\ g_2^U + e_t^U$$

stock to (8B). In other words, a rural migrant to an urban market would expect to earn

$$\ln Y_t^{UR} = g_0^R + H_t^U\ g_1^R + X_t^R\ g_2^R + e_t^R$$

and an urban migrant to a rural market would expect

Applying (8A) and (8C), relative expected incomes for rural residents in rural and urban

$$\begin{aligned}\ln\left(Y_t^R / Y_t^{RU}\right) &= \left(g_0^R - g_0^U\right) + H_t^R\ \left(g_1^R - g_1^U\right) + X_t^R\ g_2^R - X_t^U\ g_2^U + \left(e_t^R - e_t^U\right)\\ &= \ln\left(Y_t^R\right) - H_t^R\ g_1^U - g_t\end{aligned}$$

areas can be written

where $g_t = g_0^U + X_t^U\ g_2^U$ is a time t-specific fixed effect across all rural areas. The rationale for the latter restriction is that rural residents can migrate to any urban area, so urban attributes X_t^U and g_0^U have identical expectations across all rural counties. Similarly, expected unobserved incomes have expectation $E(e_t^U) = 0$ for all rural counties.

Equation (9) reflects relative expected wages for rural residents in rural and urban areas. Similarly, for urban residents, relative expected income in rural and urban areas, using (8B) and

$$\ln \left(Y_t^{UR} / Y_t^{U} \right) = \lfloor \left(g_0^R - g_0^U \right) + H_t^U \left(g_1^R - g_1^U \right) + X_t^R \; g_2^R - X_t^U \; g_2^U + \left(e_t^R - e_t^U \right) \rfloor$$
$$= \ln\left(Y_t^R\right) - H_t^R \; g_1^R - g_t^{'}$$

(8D) is

Urban migrants to a rural county can come from any urban area. Taking expectations across all urban areas which could potentially have residents migrate to rural areas, expected urban market attributes X_t^U, and expected urban human capital H_t^U, will be the same for every rural area. In addition, $E(e_t^U) = 0$. Therefore, (9A) is the logarithm of rural income minus the value of rural human capital and minus a time t-specific term, $g_t^{'} = g_0^U + H_t^U \left(g_1^R - g_1^U \right) + X_t^U \; g_2^U$ which is identical across all rural counties.

Expected incomes in rural areas will be a weighted average of expected income of current rural residents and expected income of urban residents were they to move to a rural area. A similar weighted average across urban and rural residents generates expected urban incomes. Let a_R be the proportion of the total population that is rural and let $(1-a_R)$ be the proportion urban.

$$\ln \left(Y_t^R / Y_t^U \right) = \ln \left(\frac{a_R \, Y_t^R (1 - a_R) \, Y_t^{UR}}{a_R \, Y_t^{RU} (1 - a_R) \, Y_t^U} \right) = \ln \left(\frac{Y_t^R \, Y_t^{UR}}{Y_t^{RU} \, Y_t^U} \right)$$
$$= 2 \ln \left(Y_t^R \right) - H_t^R \left(g_1^U + g_1^R \right) - \left(g_t + g_t^{'} \right)$$

The ratio of rural to urban expected wages is a weighted average of equations (9) and (9A):

Equation (10) is inserted into (7) as the measure of expected income in rural and urban markets. Equation (7) can be further simplified by noting that all urban variables have identical expectations across rural counties. Consequently, expected urban commuting costs, C^U_t, urban prices, P^U_t, and urban amenities, Z^U_t are the same for all rural residents because rural residents

$$\ln\left(M^R_{t+1}/M^R_t\right) = \beta_0' + 2\ln\left(Y^R_t\right)\beta_1 - H^R_t\left(\gamma^R_1 + \gamma^U_1\right)\beta_1 + \ln\left(C^R_t\right)\beta_2 + \ln\left(P^R_t\right)\beta_3 + \ln\left(Z^R_t\right)\beta_4 + \varepsilon^R_{t+1}$$

can move to any urban market. Applying this logic to (7), we obtain

where $\beta_0' = \{\beta_0 - (\gamma_t + \gamma_t')\beta_1 - \ln(C^U_t)\beta_2 - \ln(P^U_t)\beta_3 - \ln(Z^U_t)\beta_4 + \ln(\delta^U/\delta^R)\beta_5\}$ is a time-specific constant term.

Equation (11) implies that explainable relative population growth or decline from period t to t+1 across rural areas will depend only on relative rural characteristics including average rural income, rural human capital stock, job search and commuting costs, cost of living and rural amenities.[6] The parameters in (11) enable us to derive several implications. First, $ß_1 > 0$, so an increase of rural income must increase rural population, other things equal. Second, the coefficients on rural income and human capital allow us to investigate whether rural areas suffer from brain drain: the tendency to lose more highly educated rural residents. The derivative of

$$\frac{d\ln\left(M^R_{t+1}/M^R_t\right)}{d\,H^R_t} = 2\beta_1\gamma^R_1 - (\gamma^R_1 + \gamma^U_1)\beta_1 = \beta_1(\gamma^R_1 - \gamma^U_1)$$

population growth with respect to rural human capital, using (8A) and (11), is

Rural areas will suffer from brain drain if $\gamma^U_1 > \gamma^R_1$, meaning that marginal human capital returns are higher in urban than rural markets. We can establish estimates of $ß_1\,(\gamma^R_1 - \gamma^U_1)$ as the coefficient on H^R_t in the reduced form of equation (11). Alternatively, an auxiliary regression of equation (8A) yields an estimate of g_1^R which can then be used to derive an estimate of g_1^U, given estimates of $2ß_1$ and $(g_1^R + g_1^U)\, b_1$ in (11). Finally, the remaining coefficients $ß_2$ through $ß_4$ yield the direct effect of the remaining rural variables on rural population growth.

III. <u>Data</u>

Our aim is to establish which factors cause rural counties to grow or decline over the 1950-1990 period. Therefore, it is critical that the universe of rural counties be defined using 1950 population figures and not current definitions. As rural counties grow, they change from rural to urban designation. Consequently, a sample of rural counties as designated in 1990 would select out the rural counties that have grown the most.

Calvin Beale developed a designator for the degree of urbanization of a county. Because these definitions were developed for the 1980 Census, we applied them to the 1950 data. We designated a county as rural or nonmetropolitan if it fit the criteria for Beale Codes 6-9 in 1950: total urban population under 20,000.[7] We also required that the county have a farm population of at least 400 in 1960 because 1960 farm population statistics were not reported for counties below that level.

Because the data requirements were extensive, we created a stratified random sample of the 1,266 counties in the midwest and the south. Those states were selected because they offered relatively equal-sized counties with a fair degree of homogeneity in agricultural production. From each state, 18 rural/nonmetropolitan counties were drawn from the state's universe of qualifying counties in 1950. This resulted in a sample size of 306 counties per Census year.[8]

The focus of the study is to examine how job market attributes affect incentives to reside in rural areas. For this reason, we concentrated on individuals in the working-age range of 20-64. Because theory suggests that incentives to migrate are strongest among the young, we also examined changes in the young working-age population, 20-34. Details on data sources and definitions for the endogenous variables are reported in the Appendix. An additional advantage of concentrating on these age groups is that ten-year changes in population over 20 cannot be due to births over the period, and deaths are a relatively unimportant source of changes in these populations. Therefore, these populations closely fit the theoretical model that deals with net migration.

The independent variables include income, human capital, local amenities, cost-of-living, government tax and expenditure policies and job search and commuting costs. A summary of variable definitions and sources is listed in the Appendix. Rural income is measured as the median family income divided by persons per family.

Human capital, H_t^R, is measured by two variables: median school year completed for those over age 25 and percentage for those over age 25 and percentage of population with at least a high school degree. These two effects are aggregated to capture the human capital effect on population change.

There is no county-level cost-of-living series, but there are several measures which partially control for local prices, P_t^R. These include measures of local amenities because nicer places will have higher land prices.[9] Local amenities are measured by average temperature in January and July and average annual rainfall. Changes in rural cost-of-living over time are captured by dummy variables for each decade. In addition, local government services may attract residents, but these must be paid for by local taxes. Government fiscal policies will be dealt with in more detail below.

Residents of rural areas may have access to urban labor markets if they are within commuting distance of a city. Commuting and job search costs, C_t^R, are assumed to increase with distance to the nearest city of at least 100,000 population in 1950. Because urban markets have grown much more rapidly than rural markets, ability to tap into an urban market may enable a rural county to maintain or increase population, even as other rural countries decline.

Holding fixed county income, job search costs are assumed to be lower when there are many different industries represented in the rural labor market. Davis, Haltiwanger and Schuh (1996) found very large annual rates of job creation and destruction. Almost one in five jobs in manufacturing is either newly created or destroyed per year. Such a large amount of churning in jobs requires a flexible labor market if unemployment is to be avoided. To the extent that labor demand shocks are not perfectly correlated across industries, a diversified rural economy will have a higher probability of offering alternative employment opportunities when a given industry experiences a reduction in labor demand. On the other hand, if only one industry employs rural labor, a shortfall in demand will force rural residents to search longer in the local labor markets or migrate elsewhere for employment. A Herfindahl index was computed using 10 one-digit level employment shares for each county.[10] Higher values of the Herfindahl index would be associated with a less diversified economy and higher rural job search costs.

Incentives to migrate may differ due to differences among demographic groups, so controls for percentage of blacks and percentage of farm population are included. Theory suggests costs of moving are greater for families, so percentage of population below 15 years of age controls for the influence of dependents on migration. Those over 65 are also potential dependents and might constrain incentives to move. The age distribution measures also help to correct for nonmigration population changes due to births and deaths since younger populations would be expected to have more births and older populations would have more deaths.

IV. **Government Fiscal Policy**

Local government tax and expenditure policies may increase or decrease incentives to reside in a rural area. Better government services would induce entry, whereas higher taxes raised to pay for the services would induce exits. In Hamilton's (1976) version of the Tiebout model in which residents migrate to the area that offers their optimal policy mix, property taxes raised for local services will behave as if they were expenditures on a consumption good. Consequently, the tax and expenditure policies will have equal but opposite effects on population.[11]

Government policy measures are not reported in Census years. Instead, when the Census of Population is released for year t, the Census of Government is released for years t+2 and t+7. Government policy decisions made in years t+2 and t+7 may be in response to observed population changes after time t rather than causing population changes. To remove this endogeneity, we need to measure expected government policy conditioned on information available at time t. Let W_t be a vector of input prices and tastes for local government services, sources of local government revenue, and other variables believed to influence local government

$$G_{t+n} = a_0 + W_t \ (D_n a_2 + (1 - D_n) a_7) + e^{G}_{t+n}, \ n = 2, 7$$

demand. A government policy variable, G_{t+n}, can be predicted based on a regression of the form where D_n is a dummy variable that takes the value of 1 if n=2 and 0 if n=7. Because all regressors include information available at the start of the decade, we can use (12) to project government policy two and seven years into the decade. Absent any clear preference for using the two-year-ahead versus the seven-year-ahead projection, we opted to average the two.

The period t projected government policy is of the form

$$.5E(G_{t+2} \_ W_t) + .5E(G_{t+7} \_ W_t) = a_0 + W_t(.5a_2 + .5a_7)$$

where a_2 is the vector of parameters for the two-period ahead forecast and a_7 is the vector of parameters for the seven-period ahead forecast.

V. Results

Table 1 shows the distribution of population growth rates by decade. The overall rural working age population rose 20 percent between 1950 and 1990. After a decade of population losses in the 1950s, the rural population of those aged 20-64 rose on average in the 1960s, 1970s, and 1980s. The fastest growth was in the 1970s. The pattern is similar for the young rural working age population, except that their population declined in the 1980s after two decades of growth.

The more important result is that rural county population growth rates vary tremendously across counties and across decades. This heterogeneity underlies the need to study rural population growth at the county level rather than the state or national level. Over the sample period, ANOVA analysis suggests that only twenty percent of the variance in county rural population growth rates can be explained by state or national level variables, leaving eighty percent of the variance in county population growth rates that must be explained by variables that vary across or within counties.

A. Results for Aggregate Rural Populations

Estimates of equation (11) are reported in Table 2. The model explains 41 percent of the variation in county working-age population growth, and 49 percent of the variation in young working-age population growth. The model should fit better for younger workers who are more responsive to inducements to move because of their longer time to recoup the costs of the investment.[12]

As required by the theory, rural incomes have a positive, albeit small and insignificant impact on population growth. Applying equation (11), the impact is one-half the coefficient in Table 2, so the estimates of $ß_1$ = .06 for the working-age population and .09 for the young group. The coefficients imply that if rural income is held fixed, then a ten percent increase in human capital (equivalent to a simultaneous ten percent increase in median school years and in the percentage with high school degrees) lowers the working age population by 1.5 percent and lowers the young working age population by 3.3 percent.

However, that interpretation ignores the impact of human capital on rural income and that equation (11) requires that the coefficient on $H_1^R [= - b_1 (g_1^R + g_1^U)]$ must be negative if the theory is supported by the data. Nevertheless, the relative magnitudes of g_1^R and g_1^U can be established by estimating the reduced form version of (11). These regressions[13] show that the estimate of $b_1 (g_1^R - g_1^U)$ = -.16 for the full working age population and -.31 for the young subset. Thus, relative returns to human capital are higher in urban than in rural counties so that high levels of human capital cause migration out of rural counties. This conclusion is supported by an auxiliary regression of (8A) which yields an estimate of g_1^R, which is then applied with the estimate of $ß_1$ to derive the value of g_1^U. The auxiliary regression yielded an implied return to human capital of .346.[14] Therefore, the estimate of $b_1 (g_1^R - g_1^U) = 2 b_1 g_1^R - b_1 (g_1^R + g_1^U)$ = (.12)(.346) - .15 = -.11 for the full group and (.18)(.346) - .33 = -.27 for the young working-age group. Both analyses suggest brain drain from rural to urban counties for the best educated, with the largest effect among the young.

Proximity to an urban area and a diverse rural labor market are also important avenues toward increased rural population growth. The elasticities are small with magnitudes between

-.03 to -.17, but highly significant. They imply that rural county working age populations grow faster when residents can access a wide range of jobs, either locally or in a nearby city. A plausible inference is that an industrially diverse local economy can accommodate employment shocks in a given industry more readily because workers can switch jobs without being forced to move away.

Expected government tax and expenditure policies have various effects, although most are small and insignificant. The most notable is that increased per capita taxes significantly lower population. Rural county road expenditures increase rural population growth rates, but state-wide expenditures lower population growth. Nevertheless, the more important issue is whether county tax and expenditure policies in the aggregate can affect rural population growth. In the first two columns of Table 3, we report estimates of the population growth elasticities with respect to increases in all county government expenditures, equiproportional increases in county expenditures and taxes, and equiproportional increases in county expenditures, taxes, and debt. Increases in local government services do raise rural county population growth rates, but the effects are very small and insignificant. Having to pay for these services through taxes or debt lowers the effects still further. The conclusion from Table 3 is that the combined effects of county government tax and expenditure policies have neutral effects on rural working age populations. Thus, rural governments cannot expect to raise or lower their populations by altering the provision of public services, government revenues, or the mix of current versus future financing.

The demographic variables have small effects on population growth rates. The age structure variables are jointly insignificant, although the signs are consistent with the prediction that increased proportion of the population in the dependent age groups should lower incentives to migrate. More heavily agricultural counties and counties with a higher proportion of blacks grew more slowly than other counties, but the effects are extremely small.

B. Simulations

In general, the elasticities in Table 2 are quite small. Nevertheless, these explanatory variables can be quite important in explaining differences in population growth rates if the variables change extensively across counties or across time. Evidence to that effect is presented in the form of time-series and cross-sectional simulation exercises.

The baseline case for the time series simulations predicts county population growth, holding all exogenous variables at their 1950 average levels. Next, population growth was simulated, allowing a given exogenous variable to change from its 1950 level to its 1980 level, holding all other variables at their 1950 levels. The difference between the latter estimate and the baseline is interpretable as the exogenous variable's ceteris paribus impact on population growth between 1950 and 1990.

The second simulation exercise predicted population growth when a given exogenous variable was set at its minimum and maximum values, holding all other variables at their 1950 average levels. The difference between the two simulated population growths can be interpreted as the cross-sectional impact of the variable on county population growth at one point in time.

The time series simulations show that rural population growth has been retarded most by improvements in human capital stock over time. Human capital improvements decreased the rural working age population by 5.4 percent, other things equal, and decreased the young working age population by almost 10 percent. In contrast, changes in rural income have had only a very small adverse effect on rural population growth. Rural markets have become more diversified over time (as indicated by falling Herfindahl indexes), which has tended to increase rural population growth.

The cross-sectional simulations are reported as the difference in predicted population growth between two otherwise identical counties, one of which has the highest and the other the lowest value of a given exogenous variable. The biggest simulated effects are for the young working age group. The Herfindahl index has the biggest impact, accounting for differences in population growth rates of 25 to 39 percentage points between otherwise identical counties. Rural income is also very important, accounting for differences in population growth of 24 to 36 percentage points. Variation in human capital stock can account for differences of 16 to 31 percentage points. Variation in proximity to a central city accounts for deviations of 11 to 15 percentage points. These simulated effects demonstrate the importance of income, human capital, and local labor market attributes in explaining variation in rural population growth rates over time and across counties.

C. Rural and Nonfarm Population Growth

Much of the interest in rural development policies concerns interests in maintaining farm populations. Because over half of farm income is earned off the farm[15], many presume that nonfarm income is critical to maintaining farm populations. At the same time, government programs to support farm prices have been argued to spillover to the nonfarm sector, maintaining nonfarm populations. This view has been challenged recently by Goetz and Debertin (1996) who found that larger percentages of farm income derived from government program payments reduced farm plus nonfarm population growth between 1980 and 1990. Their empirical work does not address the question of whether the decline is in the farm or the nonfarm population.[16] This section examines the determinants of population change of these two subsectors of the population.

The dependent variables are the percentage changes in county farm and county nonfarm populations. The definition of the farm population changed in 1980, so unpublished Census data applying the 1970 definition to the 1980 population were used to obtain consistent measures of the percentage change in population. The summary of farm and nonfarm population growth indicators is shown in Table 1. As with the overall rural population, there is tremendous variation in farm and nonfarm population growth rates across time and across counties. Nevertheless, the overall story is consistently that farm populations decline and nonfarm populations increase on average in every decade. This section attempts to establish why these differences between the farm and nonfarm population growth trends exist.

Independent variables are generally the same as those used to explain changes in the overall population. Farm and nonfarm specific measures are used for the income and age distribution measures, and other variables are the county averages used in Table 2.[17] The farm income measure was not available directly. Instead, farm income was derived from aggregate county income minus aggregate nonfarm income and dividing by farm population. Additional error measurement was introduced because of changing definitions of farm and of household. Because these measures of farm and nonfarm income are subject to multiple sources of measurement error, the generated farm and nonfarm incomes were regressed on a set of instruments and the fitted values were used as regressors.[18] The instruments included those in Table 2 plus measures of farm and nonfarm capital stock (value of land and buildings per acre, average size of farm, median gross monthly rent) and type of farm operation (share of crops in total farm production). The instrumenting equation also allowed us to predict incomes in 21 cases for which the Census did not report nonfarm incomes.

The results of the farm and nonfarm population growth equations are reported in Table 5. As before, the model explains population changes for the young working age group better than it does for the working age population in general. The results point to several major differences between the factors affecting the farm and nonfarm population growth rates. As predicted, farm populations respond positively to farm income and nonfarm populations increase with nonfarm income. However, the cross income effects are both negative, implying a lack of positive spillover income effects across the farm and nonfarm sectors. Similarly, more diverse employment opportunities as measured by proximity to an urban labor market or a low local Herfindahl index help to increase nonfarm populations, but they work in the opposite direction for the farm population. These outcomes suggest sharp differences across the farm and nonfarm populations in the sources of returns to rural residence.

The results in Table 5 suggest that brain drain is largely a phenomenon of the farm sector, and of the young farm population in particular. The reduced form estimate of $b_1(g_1^R - g_1^U)$ was -.21 for the farm population as a whole and -.53 for the young farm population. The structural estimates for the farm population using the auxiliary regression were -.03 and -.43 respectively. These large differences between urban and rural returns to human capital in the farm population are consistent with the large movement of labor out of agriculture that has occurred.[19] In contrast, the estimated differences in returns to education between urban and rural areas for the nonfarm working-age population were much smaller and not precisely estimated.

Government policy effects are generally consistent between the farm and nonfarm sectors. The neutrality tests reported in Table 3 for the farm and nonfarm sectors show that the nonfarm working age population and both young working age populations are not significantly affected by local government expenditure or tax policies. The farm working age population actually decreases as local government services are expanded. Overall, these findings do not support a strong role for local government tax or expenditure policies in affecting population growth.

VI. Conclusions

There is tremendous variation in population growth rates across rural counties. As a result, empirical work based on data aggregated to the state or national levels misses the vast majority of the variation in growth rates that occurs within states. Some of the variation is missed by restricting analysis to counties currently designated as rural. Exclusion of previously rural counties that have outgrown the designation undersamples the most rapidly growing rural counties and oversamples relatively unsuccessful counties.

The data are applied to a model of changes in the working-age population based on the human capital investment model of migration. The model successfully predicts the effects of rural income, commuting cost, and job search costs on population growth. The model's success suggests that the human capital model offers a parsimonious framework for analyzing population changes in rural areas.

The empirical estimates yield the following conclusions:

1) Rural per capita real income has a small positive effect on rural population growth. A small decrease in real income over time has led to a small decrease in average rural population over the sample period. However, counties with the highest per capita incomes grow 23-35 percent faster per decade than do the lowest income counties.

2) As distance to a major city increases, a county grows more slowly. The effect is constrained to zero over time. However, in cross-section, rural counties close to a city grew 11-15 percent faster than the most remote counties.

3) Employment concentration, as measured by the Herfindahl Index, leads to slower population growth. The increase in employment diversification of rural counties over time has contributed modestly to county population growth. The larger effect is across counties, where the most diversified counties have population growth rates 25-39 percentage points higher per decade than do the most concentrated counties.

4) Human capital has higher returns in urban areas. The effect is particularly evident in the farm population and in the young. As a consequence, the incentive to leave rural areas increases with years of education. Increased education levels have retarded population growth by 5-10 percentage points between 1950-1990. Counties with more highly educated populations experience population growth 16-31 percentage points slower than counties with the least educated populations.

5) Young working age populations are more sensitive to economic incentives to move or stay, consistent with the human capital hypothesis.

6) There is no evidence of positive feedback of income growth across the farm and nonfarm populations. Higher farm income decreases nonfarm population, even as it increases the farm population. Higher nonfarm income increases nonfarm population, but retards farm population growth.

7) What positive effects there are from local government provision of services are counteracted by the negative consequences of raising taxes and/or debt.

Table 1: Rural county population growth rates in the Midwest and South, 1950-1990 (in percentages).

	Individuals aged 20-64			Individuals aged 20-34		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
1950-1960						
County	-78.80	-9.31	384.29	-83.61	-20.58	901.35
Farm	-90.42	-38.51	-9.06	-94.76	-53.84	-20.04
Nonfarm	-85.49	17.53	735.16	-87.28	5.85	1497.65
1960-1970						
County	-60.78	2.68	256.52	-63.15	9.94	756.61
Farm	-77.32	-30.60	91.53	-88.18	-35.74	148.93
Nonfarm	-58.08	18.57	301.73	-60.52	27.61	810.80
1970-1980						
County	-27.21	11.07	77.41	-27.21	11.07	77.44
Farm	-84.39	-15.23	106.25	-84.45	-15.25	105.56
Nonfarm	-25.44	21.19	109.31	-26.06	18.48	89.16
1980-1990						
County	-26.71	1.56	92.85	-44.69	-7.24	264.87
Farm	-68.74	-30.68	324.14	-81.55	-31.50	705.00
Nonfarm	-24.26	8.24	117.98	-39.93	-2.65	292.82
1950-1990						
County	-65.88	19.85	683.86	-71.22	21.74	683.67

Note: Mean growth rates are the unweighted average of 306 county growth rates.

Table 2. Regressions of rural county population growth rate in the Midwest and South, by decades, 1950-1990 (all variables in natural logarithms)

Explanatory variables	Individuals aged 20-64	Individuals aged 20-34
Rural average income	0.12	0.18
	(1.35)	(1.16)
Human Capital		
Median school years completed	-0.15	-0.35
	(-1.88)	(-3.06)
Percentage of population with high school degree	-0.00	0.02
	(-0.05)	(0.42)
Local Commuting, Job Search		
Distance to a city with population > 100,000	-0.03	-0.04
	(-2.52)	(-2.36)
Herfindahl index of employment	-0.11	-0.17
	(-3.33)	(-3.72)
Government		
Predicted local government tax revenue (per capita)	-0.11	-0.11
	(-4.03)	(-2.89)
Predicted local government education expenditure (per capita)	-0.02	0.02
	(-0.37)	(0.23)
Predicted local government LR debt outstanding (per capita)	0.03	-0.02
	(0.54)	(-0.21)
Predicted local government public welfare expenditure (per capita)	0.02	0.03
	(1.69)	(1.84)
Predicted local government highway expenditure	0.05	0.05
	(2.74)	(2.35)
State government highway expenditure (State level)	-0.06	-0.09
	(-4.25)	(-4.40)
Demographics		
Percentage of farm population	-0.02	-0.02
	(-2.28)	(-1.84)
Percentage of blacks in total population	-0.01	-0.01
	(-4.26)	(-2.77)
Percentage of population less than 15 years old	-0.07	-0.20
	(-0.76)	(-1.73)
Percentage of population 65 years and over	-0.03	-0.03
	(-0.91)	(-0.64)
F value	37.82	51.46
N	1224	1224
R^2	0.41	0.49

t-values corrected for heteroskedasticity are in parentheses. Regressions also included dummy variables for each decade, measures of average county rainfall, January and July temperature, and a dummy variable for Shannon County, South Dakota, which had no county government.

Table 3: Neutrality tests of local government fiscal policy.

Test: Neutrality of	Full county population		Farm population		
	Aged 20-64	Aged 20-34	Aged 20-64	Aged 20-34	A
A. Local government expenditure	0.05[a] (0.61)[b]	0.10 (1.46)	-.234 (6.01)	-.139 (1.51)	
B. Local government expenditure plus tax	0.00 (1.31)	0.09 (0.01)	-.183 (3.43)	-.030 (.07)	
C. Local government expenditure plus tax plus debt outstanding	-0.03 (0.30)	0.07 (0.07)	-.199 (5.53)	-.017 (.03)	

[a]Elasticity of population growth with respect to the corresponding policy.

[b]Wald statistic. The critical value of ?^{2} with one degree of freedom is 3.84 at the .05 level of significance.

Table 4: Simulated Change in Population (in percentage points) Attributable to Rural Income, Human Capital, Proximity to Urban Labor Market, and Industrial Diversity, by Age Group.

	Population Aged 20-64		Population Aged 20-34	
	Time Series[b] 1990-1950	Cross-Section[c] 1950	Times Series[b] 1990-1950	Cross-Section[c] 1950
Income (+)[a]	-0.89	23.92	-1.32	35.55
Human Capital (-)	-5.43	-16.21	-9.87	-31.19
Distance to City (-)	—	-11.48	—	-15.49
Herfindahl Index (-)	3.70	-24.92	5.76	-38.84

[a]Signs of the regression coefficients are in parentheses.

[b]Difference in simulated percentage growth in population when the variable is set at its 1950 sample mean and when it is set at its 1980 sample mean, holding all other variables at their 1950 sample means.

[c]Difference in simulated percentage growth in population when the variable at its lowest observed value and when it is set at its highest value, holding all other variables at their 1950 sample means.

Table 5: Regressions of rural farm and nonfarm population growth rates, by decade.

Explanatory variables	Individuals aged 20-64		Indivi
	Farm population	Nonfarm population	Farm populatic
Predicted farm income	.725 (5.66)	-.391 (5.37)	. (5
Predicted nonfarm income	-.116 (.75)	.289 (2.82)	-. (
Median school years completed	-.377 (2.02)	.188 (1.46)	-. (3
Percentage of population with high school degree	.036 (.45)	-.096 (1.81)	. (
Distance to a city with population > 100,000	-.01 (.48)	-.039 (3.23)	. (
Herfindahl index of employment	.092 (2.39)	-.024 (.64)	. (2
Percentage of population less than 15 years old	-.349 (4.40)	.093 (1.28)	-. (2
Percentage of population 65 years and over	-.126 (3.34)	-.025 (.77)	-. (2
Predicted local government tax revenue (per capita)	.051 (1.10)	-.114 (3.25)	. (1
Predicted local government education expenditure (per capita)	-.093 (1.07)	-.089 (1.49)	-. (
Predicted local government LR debt outstanding (per capita)	-.016 (.31)	.042 (.95)	. (

Table 5 (continued)

Explanatory variables	Individuals aged 20-64		Indivi
	Farm population	Nonfarm population	Farm populatio
Predicted local government public welfare expenditure (per capita)	.026	.028	.
	(1.86)	(2.11)	(2
Predicted local government highway expenditure	-.147	.072	-.
	(4.37)	(3.64)	(3
State government highway expenditure (State level)	.021	-.042	-.
	(.98)	(2.85)	(1
Percentage of blacks in total population	-.001	-.030	-.
	(.09)	(8.40)	(
F value	35.6	22.4	4
N	1224	1224	1
R^2	.39	.29	

t-values corrected for heteroskedasticity are in parentheses. Regressions also included dummy variables for each decade, rainfall, January and July temperature, and a dummy variable for Shannon County, South Dakota, which had no county gc

References

Ahearn, Mary C., Janet E. Perry, and Hisham El-Osta. The Economic Well-Being of Farm Operator Households, 1988-90. USDA-ERS Agricultural Report No. 666. Washington DC. January, 1993.

Barkley, Andrew P. "The Determinants of the Migration of Labor Out of Agriculture in the United States, 1940-85." American Journal of Agricultural Economics 72 (August 1990):567-573.

Butler, Margaret. Rural-Urban Continuum Codes for Metro and Nonmetro Counties. USDA Staff Report No. 9028. Washington DC. 1990.

Davis, Steven J., John C. Haltiwanger, and Scott Schuh. Job Creation and Destruction. Cambridge, MA: MIT Press. 1996.

Goetz, Stephan J., and David L. Debertin. "Rural Population Decline in the 1980s: Impacts of Farm Structure and Federal Farm Programs." American Journal of Agricultural Economics 78 (August 1996):517-529.

Gyourko, James and Joseph Tracy. "The Structure of Local Public Finance and the Quality of Life." Journal of Political Economy 99 (August, 1991):774-806.

Hamilton, Bruce W. "Capitalization of Interjurisdictional Differences in Local Tax Prices." American Economic Review 66 (December 1976):743-753.

Huang, Tzu-Ling. "The Determinants of Rural Population Growth and Decline, 1950-1990: The Roles of Government Policy, Human Capital, and Farm and Nonfarm Income." Unpublished dissertation. Iowa State University. 1996.

Huffman, Wallace E., and Mark Lange. "Off-farm Work Decisions of Husbands and Wives: Joint Decision Making." Review of Economics and Statistics 71(August 1989): 471-480.

Johnson, D. Gale. "Contribution of Price Policy to the Income and Resource Problems in Agriculture." Journal of Farm Economics 26 (November 1944):631-664.

Kislev, Yoav and Willis Petersen. "Prices, Technology and Farm Size." Journal of Political Economy 90 (June 1982):578-95.

Mieszkowski, Peter and George R. Zodrow. "Taxation and the Tiebout Model: The Differential Effects of Head Taxes, Taxes on Land, Rents and Property Taxes." Journal of Economic Literature 27 (September, 1989):1098-1146.

Mincer, Jacob. "Family Migration Decisions." Journal of Political Economy 86 (October 1978):749-773.

Schultz, Theodore W. Agriculture in an Unstable Economy. New York: McGraw Hill. 1945.

Sjaastad, Larry A. "The Cost and Returns of Human Migration." Journal of Political Economy 70 (October 1962):80-93.

Tokle, Joanne G., and Wallace E. Huffman. "Local Economic Conditions and Wage Labor Decisions of Farm and Rural Nonfarm Couples." American Journal of Agricultural Economics 73 (August 1991):652-670.

---

1. Examples include Johnson (1944), Schultz (1945), and Barkley (1990).

2. Ahearn, Perry, and El-Osta (1993), Table 45, report that wage, salary and off-farm business accounted for 65 percent of farm income in 1988. Huffman and Lange (1989), and Tokle and Huffman (1991) have shown that nonfarm wages affect off-farm labor supply choices. Tokle and Huffman also analyze labor supply decisions for nonfarm, nonmetropolitan populations. These studies examine labor supply choices conditional on nonmetropolitan residence, and do not consider migration decisions.

3. Between 1990 and 1995, 12 of the 176 major articles published in Rural Sociology were on aspects of U.S. rural migration or population growth. This 6.8 percent share may be too conservative. Garkovich and Bell (1995) placed the share of all Rural Sociology articles and communications on this topic at 11.1 percent over the 1986-1995 period. The sociological studies typically use combinations of demographic variables and employment distributions to explain population change, bearing little resemblance to the human capital investment approach to migration commonly used by economists since the work of Sjaastad (1962) and Mincer (1978).

   Barkley (1990) adopted the human capital framework in explaining changes in the number of farmers in the nation, but that was the only paper on the topic of the 583 major articles in the American Journal of Agricultural Economics between 1990 and 1995, a share of about 0.3 percent. Recently, Goetz and Debertin (1996) published a paper on the roles of farm credit payments, industry employment and industry income on county population growth. Ironically, that study bears a closer resemblance to the sociological models than to the human capital migration models.

4. '$\vee$' symbolizes 'or', and '$\wedge$' symbolizes 'and'.

5. Note that Install Equation Editor and double-click here to view equation. when

   Install Equation Editor and double-click here to view equation. is small relative to Install Equation Editor and double-click here to view equation. .

---

6. Note that by construction, this specification avoids simultaneity problems. Specific destination attributes are endogenous, and so are not included. Rural market attributes may change as population changes, and so changes in rural attributes between t and t+1 are also excluded as regressors.

7. For a discussion of Beale Codes, see Butler (1990).

8. According to 1990 Beale Codes, 48 of these rural counties as of 1950 were no longer considered rural in 1990. This reinforces the need to define rural status on the basis of population at the beginning of the sample period to insure the inclusion of growing counties.

9. See Gyourko and Tracy (1991) for analysis of the impact of local amenities on wages and property values.

10. The Herfindahl employment index for a county is Install Equation Editor and double-click here to view equation. , where E_j is employment in

industry j and E is total employment in the county. The index varies between zero and one, with one meaning all employment is in a single sector.

11. Mieszkowski and Zodrow (1989) review the literature on Tiebout models of local expenditure.

12. Mincer (1978) showed that migration rates decline as age increases.

13. The reduced-form regressions are available on request.

14. The auxiliary income equations are available on request.

15. Ahearn, Perry, and El-Osta (1993), p. 12.

16. It is difficult to compare the results reported herein with those in Goetz and Debertin (1996) because of the very different modeling strategies. Goetz and Debertin (p. 522) justify their exclusive reliance on county attributes rather than human capital measures because of an asserted failure of the latter to generate reasonable parameter estimates in previous work. Our findings herein suggest that the abandonment of the human capital framework in aggregate studies may have been premature.

17. Ideally, we would use farm and nonfarm human capital measures, but only county-level measures were available.

18. A Hausman specification test of whether measured income should enter the equation strongly rejected the use of measured farm and nonfarm incomes, supporting the use of the instrumented farm and nonfarm incomes. In contrast, a comparable test of the use of

reported median county income in the regressions reported in Table 2 failed to reject the use of reported median county incomes. We believe the difference reflects measurement errors introduced by the decomposition of county income into their farm and nonfarm components.

19. With nearly constant returns to scale in farming, highly-educated farmers can only match their rising opportunity costs in urban markets by increasing the size of their operations. Since total arable land in a county is fixed, the only way that a farmer can expand is by buying out his neighbors. Incentives to expand are largest in highly-educated counties, leading to more rapid outmigration of those opting to sell rather than expand. This is consistent with the Kislev and Petersen (1982) evidence that increased urban wages lead to larger scale operations.