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

Tzu-Ling Huang, Peter F. Orazem, and Darin Wohlgemuth

Human capital raises rural incomes, but this effect is swamped by higher returns to human capital in urban markets. This leads to "brain drain" from rural areas. Populations grow more rapidly in rural counties that have a diversified employment base. 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, higher farm incomes lead to slower nonfarm population growth and vice versa. Rural county government services financed by local taxes or debt have neutral or negative effects on population growth.

Key words: brain drain, diversified employment, government services, human capital, rural-urban migration.

Rural population in the United States increased 53% 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 exists a concern that rural areas are threatened by population declines that 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 slowly 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 future viability of rural communities. On the other hand, off-farm employment opportunities are increasingly important to the sustainability of farm households, representing half or more of farm income.[1] 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. Consequently, the future sustainability of the farm population may be tied to the economic health of the nonfarm population.

The outflow of labor from agriculture has been widely studied,[2] but agricultural economists have usually looked at the issue without considering the overall rural labor market. In contrast, change in the overall rural population is a major focus of research in rural sociology.[3] Since Sjaastad's pioneering work, economists have had a very successful model of

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[1] Ahearn, Perry, and El-Osta, table 45, report that wage, salary, and off-farm business accounted for 65% of farm income in 1988. Huffman and Lange, and Tokle and Huffman 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.

[2] Examples include Johnson, Schultz, Barkley, and Gisser and Davila.

[3] Between 1990 and 1995, twelve of the 176 major articles published in *Rural Sociology* were on aspects of U.S. rural migration or population growth. This 6.8% share may be too conservative. Garkovich and Bell placed the share of all *Rural Sociology* articles and communications on this topic at 11.1% over the 1986–95 period. Only one of 583 major articles in the *American Journal of Agricultural Economics* discussed the topic. Between 1996 and 2000, seven of 375 discussed aspects of rural or farm migration, but three of these dealt with countries other than the United States and two were primarily interested in rural economic development.

migration behavior, based on the human capital investment approach. However, typically, the rural sociology papers have not applied the human capital perspective.[4]

This study applies an empirically tractable human capital model to data on population growth for a sample of 306 Southern and Midwestern rural counties over the 1950–90 period. The long time period allows us to include counties that were rural in 1950 but have grown beyond the rural designation. Studies concentrating on more recent periods have eliminated these fastest growing counties from the analysis. It is not clear that the inferences drawn regarding population growth will be valid when the sample is restricted to the slower growing counties that remained rural. Questions addressed include:

- How sensitive is rural population growth to rural income?
- Are rural counties subject to "brain drain" so that improved educational attainment leads to slower population growth?
- Should rural counties concentrate on 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 younger rural populations more sensitive to economic factors than older populations?
- Are farm populations more sensitive to economic factors than nonfarm populations?
- Do increasing farm incomes increase nonfarm population growth? Do increasing nonfarm incomes raise farm population growth?

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

[4] 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 and Mincer. Barkley and Gisser and Davila adopted the human capital framework to explain migration out of farming or farm labor. Articles that looked at rural populations more broadly (Goetz and Debertin, Wojan) use methods that more closely resembled the sociological models than the human capital migration model.

Model

This section presents a model of locational preference similar to that of Barkley. Suppose that there are two regions, rural (R) and urban (U). A representative individual's expected indirect utility in region i is

$$(1) \qquad I_t^i\left(Y_t^i, C_t^i, P_t^i, Z_t^i\right); i = \mathrm{R}, \mathrm{U}$$

where utility depends positively on Y_t^i: the individual's time t expected income; negatively on C_t^i: job search and commuting costs; negatively on P_t^i: rural cost of living; positively (negatively) on Z_t^i: a vector of amenities (disamenities) in region i.

The expected net utility from residing in R relative to U at time t is $\Pi_t^{\mathrm{R}} = \mathrm{I}_t^{\mathrm{R}} - \mathrm{I}_t^{\mathrm{U}}$. Assume the utility cost of leaving R for U is δ^{U}. If Π_t^{R} is positive, or if it is negative but $|\Pi_t^{\mathrm{R}}| < \delta^{\mathrm{U}}$, then the individual will prefer to remain in R. Otherwise, the individual prefers to move to U.

Consider the change in population in R over the period t to t'. In a population of size M_t^{R}, M_t^{RR} meet the requirement that $[(\Pi_t^{\mathrm{R}}) > 0 \vee (|\Pi_t^{\mathrm{R}}| < \delta^{\mathrm{U}})]$ and remain in R. The rest, $M_{t'}^{\mathrm{RU}}$, meet the requirement that $[(\Pi_t^{\mathrm{R}} < 0) \wedge (|\Pi_t^{\mathrm{R}}| > \delta^{\mathrm{U}})]$ and move to U. The accounting identity for the rural population in period t and their state in t' is

$$(2) \qquad M_t^{\mathrm{R}} = M_{t'}^{\mathrm{RR}} + M_{t'}^{\mathrm{RU}} + d_{t'}^{\mathrm{R}}$$

where $d_{t'}^{\mathrm{R}}$ are deaths that occur between time t and time t'. A symmetric decision process would set the criteria for moving into R from U. $M_{t'}^{\mathrm{UR}}$ is the number of urban residents for whom $[(\Pi_t^{\mathrm{U}} < 0) \wedge (|\Pi_t^{\mathrm{U}}| > \delta^{\mathrm{R}})]$. Births can also occur over time, so the rural population at time t' will be

$$(3) \qquad M_{t'}^{\mathrm{R}} = M_{t'}^{\mathrm{RR}} + M_{t'}^{\mathrm{UR}} + b_{t'}^{\mathrm{R}}$$

where $b_{t'}^{\mathrm{R}}$ are births that occur between t and t'. The proportional population change in the rural area from t to t' is

$$(4) \qquad \frac{M_{t'}^{\mathrm{R}} - M_t^{\mathrm{R}}}{M_t^{\mathrm{R}}} = \frac{\left(M_{t'}^{\mathrm{UR}} - M_{t'}^{\mathrm{RU}}\right) + b_{t'}^{\mathrm{R}} - d_{t'}^{\mathrm{R}}}{M_t^{\mathrm{R}}} = \frac{N_{t'}^{\mathrm{R}}}{M_t^{\mathrm{R}}} + \beta_0 + e_{t'}^{\mathrm{R}} \approx \ln\left(\frac{M_{t'}^{\mathrm{R}}}{M_t^{\mathrm{R}}}\right)$$

where $N^{R}_{t'}$ is net inmigration into R and $\beta_0 + e^{R}_{t'} = \frac{b^{R}_{t+1} - d^{R}_{t+1}}{M^{R}_{t}}$ is the proportional change in population due to births and deaths between t and t'. The net migration component relates to the economic model directly, while births and deaths will be treated as a constant natural accretion plus a random error.[5]

Empirical Formulation

The theory implies that population changes should be a function of $Y^{R}_{t}, Y^{U}_{t}, C^{R}_{t}, C^{U}_{t}, P^{R}_{t}, P^{U}_{t}, Z^{R}_{t}, Z^{U}_{t}, \delta^{R}$, and δ^{U}. We approximate the population change in a given rural county by the following equation

$$(5)\quad \ln\left(M^{R}_{t'}/M^{R}_{t}\right) = \beta_0 + \ln\left(\frac{Y^{R}_{t}}{Y^{U}_{t}}\right)\beta_1 + \ln\left(\frac{C^{R}_{t}}{C^{U}_{t}}\right)\beta_2 + \ln\left(\frac{P^{R}_{t}}{P^{U}_{t}}\right)\beta_3 + \ln\left(\frac{Z^{R}_{t}}{Z^{U}_{t}}\right)\beta_4 + \ln(\delta^{U}/\delta^{R})\beta_5 + e^{R}_{t'}.$$

To operationalize (5), 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. Equations explaining variation in nonmover income are of the form

$$(6A)\quad \ln Y^{RR}_{t} = \gamma^{R}_{0} + H^{R}_{t}\gamma^{R}_{1} + X^{R}_{t}\gamma^{R}_{2} + \varepsilon^{R}_{t}$$

$$(6B)\quad \ln Y^{UU}_{t} = \gamma^{U}_{0} + H^{U}_{t}\gamma^{U}_{1} + X^{U}_{t}\gamma^{U}_{2} + \varepsilon^{U}_{t}$$

where ε^{R}_{t} and ε^{U}_{t} 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 stock to (6B). In other words, a rural migrant to an urban market would expect to earn

$$(6C)\quad \ln Y^{RU}_{t} = \gamma^{U}_{0} + H^{R}_{t}\gamma^{U}_{1} + X^{U}_{t}\gamma^{U}_{2} + \varepsilon^{U}_{t}$$

and an urban migrant to a rural market would expect

$$(6D)\quad \ln Y^{UR}_{t} = \gamma^{R}_{0} + H^{U}_{t}\gamma^{R}_{1} + X^{R}_{t}\gamma^{R}_{2} + \varepsilon^{R}_{t}.$$

There are two alternative ways to measure the relative expected incomes in rural and urban markets, (Y^{RR}_{t}/Y^{RU}_{t}) or (Y^{UR}_{t}/Y^{UU}_{t}). The first measures the ratio of incomes from staying in the rural areas versus moving to the urban market. The second is the ratio of expected income from moving from an urban to a rural market versus staying in the urban market.

A rural resident can migrate to any urban county, so the urban attributes γ^{U}_{0} and X^{U}_{t} would be the same regardless of the rural county of origin. Consequently, using (6A) and (6C)

$$(7A)\quad \ln\left(Y^{RR}_{t}/Y^{RU}_{t}\right) = \ln Y^{RR}_{t} - H^{R}_{t}\gamma^{U}_{1} + \gamma_t - \varepsilon^{U}_{t}$$

where $\gamma_t = -(\gamma^{U}_{0} + X^{U}_{t}\gamma^{U}_{2})$ is a time-specific effect that is constant across all rural counties. Similarly, using (6B) and (6D)

$$(7B)\quad \ln\left(Y^{UR}_{t}/Y^{UU}_{t}\right) = \ln Y^{RR}_{t} - H^{R}_{t}\gamma^{R}_{1} + \gamma'_t - \varepsilon^{U}_{t}$$

where $\gamma'_t = -(\gamma^{U}_{0} + H^{U}_{t}(\gamma^{U}_{1} + \gamma^{R}_{1}) + X^{U}_{t}\gamma^{U}_{2})$ will be a time-specific fixed effect that will not vary across rural counties. We take as our measure of relative expected incomes in rural versus urban markets the average of (7A) and (7B), so

$$(7C)\quad \ln\left(Y^{R}_{t}/Y^{U}_{t}\right) = 0.5\ln\left(Y^{RR}_{t}/Y^{RU}_{t}\right) + 0.5\ln\left(Y^{UR}_{t}/Y^{UU}_{t}\right) = \ln Y^{RR}_{t} - 0.5H^{R}_{t}\left(\gamma^{R}_{1} + \gamma^{U}_{1}\right) + 0.5(\gamma_t + \gamma'_t) - \varepsilon^{U}_{t}.$$

Equation (7C) is inserted into (5) as the measure of expected income in rural and urban markets. Equation (5) can be further simplified by noting that, as with income and human capital, all other urban variables have identical values across rural counties. Consequently, 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 can move to any urban market. Applying this logic to (5), we obtain

[5] While fluctuations in the death rate are presumably random, births may respond to local economic incentives. In the empirical work below, the gap between t and t' is 10 years and we only consider changes in population for those aged 20–64 years. Consequently, population changes cannot be due to births over the period. Also, deaths are a relatively unimportant source of population change in those age groups.

$$(8)\quad \ln\left(M_{t'}^{R}/M_{t}^{R}\right) = \beta_{0_t} + \ln\left(Y_{t}^{RR}\right)\beta_1 - 0.5H_{t}^{R} \times \left(\gamma_1^{R} + \gamma_1^{U}\right)\beta_1 + \ln\left(C_{t}^{R}\right)\beta_2 + \ln\left(P_{t}^{R}\right)\beta_3 + \ln\left(Z_{t}^{R}\right)\beta_4 + \eta_{t'}$$

where $\beta_{0_t} = \{\beta_0 + 0.5(\gamma_t + \gamma_t')\beta_1 - \ln(C_t^{U})\beta_2 - \ln(P_t^{U})\beta_3 - \ln(Z_t^{U})\beta_4 + \ln(\delta^{U}/\delta^{R})\beta_5\}$ is a time-specific constant term[6] and $\eta_{t'} = e_{t'}^{R} - \varepsilon_t^{U}\beta_1$ is a random error term.

Equation (8) implies that explainable relative population growth or decline from period t to t' across rural areas will depend only on period t rural characteristics including average rural income, rural human capital stock, job search and commuting costs, cost of living and rural amenities.[7] The parameters in (8) enable us to derive several implications. First, $\beta_1 > 0$, so an increase of rural income must increase rural population, other things equal. Second, when both rural income and human capital are included in the equation, the coefficient on human capital will be negative. This in itself does not imply brain drain; however, because human capital has an effect through rural income which must be positive. The brain drain effect is given by the derivative of population growth with respect to rural human capital. Using (6A) and (8), the brain drain effect is

$$(9)\quad \frac{d\ln\left(M_{t'}^{R}/M_{t}^{R}\right)}{dH_{t}^{R}} = \gamma_1^{R}\beta_1 - 0.5\left(\gamma_1^{R} + \gamma_1^{U}\right)\beta_1 = 0.5\left(\gamma_1^{R} - \gamma_1^{U}\right)\beta_1.$$

Rural areas will suffer from brain drain if $\gamma_1^{U} > \gamma_1^{R}$, meaning that marginal returns to human capital are higher in urban than in rural markets. We can establish estimates of $0.5(\gamma_1^{R} - \gamma_1^{U})\beta_1$ as the coefficient on H_t^{R} when $\ln(Y_t^{RR})$ is excluded from equation (8). Alternatively, an auxiliary regression of equation (6A) yields an estimate of γ_1^{R} which can then be used to derive an estimate of γ_1^{U}, given estimates of β_1 and $0.5(\gamma_1^{R} + \gamma_1^{U})\beta_1$ in (8). The remaining coefficients β_2 through β_4 yield the direct effect of the remaining rural variables on rural population growth.

Data

Our aim is to establish which factors cause rural counties to grow or decline over the 1950–90 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.

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.[8] 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.[9]

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.[10]

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 years. Because theory suggests that incentives to migrate are strongest among the young, we also examined changes in the young working-age population, 20–34 years. Details on data sources and

[6] The term $\ln(\delta^{U}/\delta^{R})$ 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. δ^{U}/δ^{R} may differ from (1) if the psychic cost of moving from R to U differs from that of moving from U to R. There may also be differences in pecuniary costs related due to different real estate transaction costs in rural versus urban markets.

[7] Note that by construction, this specification avoids simultaneity problems. Specific destination attributes are selected jointly with the decision to migrate and are therefore endogenous. Rural market attributes may change as population changes, and so changes in rural attributes between t and t' are also excluded as regressors.

[8] For a discussion of Beale Codes, see Butler.

[9] This restriction eliminated six of the 1,266 counties that could have potentially been selected for our sample.

[10] According to 1990 Beale Codes, forty-eight (4%) of these counties designated as rural in 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.

definitions for all variables are reported in an Appendix table that can be accessed at http://www.econ.iastate.edu/faculty/orazem/.

The independent variables include measures of income, human capital, local amenities, cost-of-living, government tax and expenditure policies, and job search and commuting costs. All variables are measured in logs so that the coefficients can be interpreted as elasticities.

Rural income, Y_t^R, is measured as the median family income divided by persons per family. Average income was not available for the full period.

Human capital, H_t^R, is measured by two variables: median school years completed for those over age 25 and percentage of population with at least a high school degree. While these are the only two human capital measures consistently available at the county level over the sample period, they do allow a measure of the average education and the distribution of education in the population. The total human capital effect on population change is computed as the sum of the coefficients on these two variables.

There is no county-level cost-of-living series, but medium gross monthly rent will partially control for local county prices, P_t^R. Common changes in rural cost-of-living and the effects of inflation are captured by dummy variables for each decade. Nicer places to live will have higher land prices,[11] so cost of living must be evaluated relative to local amenities. Local amenities are measured by average temperature in January and July and average annual rainfall. In addition, local government services may attract residents, but these must be paid for by local taxes.

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 counties decline.[12]

Job search costs are assumed to be lower when the local labor market is diverse. Labor markets are subject to frequent shocks.[13] To the extent that these 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 ten one-digit SIC employment shares for each county.[14] 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 years are also potential dependents and might constrain incentives to move. The age distribution measures also help to correct for nonmigration population changes due to differential death probability.

Government Fiscal Policy

Local government tax and expenditure policies may increase or decrease incentives to reside in a rural area. Better government services may induce entry, whereas higher taxes raised to pay for the services may induce exits. In Hamilton's version of the Tiebout model in which residents migrate to the area offering 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.[15]

[11] See Gyourko and Tracy for analysis of the impact of local amenities on wages and property values.

[12] Preliminary analysis using proximity to a city of 25,000 in 1950 and proximity to a city of 100,000 yielded similar results. Because some counties had grown to over 100,000 population over the period, the latter measure was rejected as being subject to reverse causality.

[13] Davis, Haltiwanger, and Schuh 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.

[14] The Herfindahl employment index for a county is $\Sigma_{j=1}^{10}(E_j/E)^2$, 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.

[15] Mieszkowski and Zodrow review the literature on Tiebout models of local expenditure.

Table 1. Rural County Population Growth Rates in the Midwest and South, 1950–90 (in %)

	Individuals Aged 20–64 years			Individuals Aged 20–34 years		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
1950–60						
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
1960–70						
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
1970–80						
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
1980–90						
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
1950–90						
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.

Measured local fiscal policies include: per capita expenditures on education and welfare; expenditures on highway; and per capita taxes and local debt. Highway expenditures are not presented in per capita terms because they represent a nonexcludable public good. These policy measures are reported in the second and seventh years of each decade. We take the average as the representative measure of the local fiscal policies. However, 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. We use a vector of government input prices and measures of tastes for local government services known at time t as instruments for the endogenous policy variables.

Results

Table 1 shows the distribution of population growth rates by decade. The overall rural working age population rose 20% between 1950 and 1990. After a decade of population losses in the 1950s, the rural population of those aged 20–64 years 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 underscores 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 20% of the variance in county rural population growth rates can be explained by state or national level variables, leaving 80% of the variance in county population growth rates that must be explained by variables that vary across or within counties.[16]

Results for Aggregate Rural Populations

Estimates of equation (8) are reported in table 2. The model explains 42% of the variation in county working-age population growth, and 49% of the variation in young working-age population growth. The human capital model predicts that the model should fit better for

[16] This is the variance that cannot be explained by a complete set of state and time dummies which will capture common effects across counties within a state and across counties in any given decade.

Table 2. Instrumental Variable Regressions of Rural County Population Growth Rate in the Midwest and South, 1950–90 (All Variables in Natural Logarithms)

Explanatory Variables	Individuals Aged 20–64 years	Individuals Aged 20–34 years
Rural median income per person	0.17	0.23
	(1.71)[a]	(1.59)
Human Capital		
Median school years completed	−0.18	−0.37
	(1.71)	(2.31)
Percentage of population with high school degree	−0.11	−0.09
	(1.26)	(0.73)
Local Economy		
Distance to a city with population>100,000	−0.005	−0.01
	(0.21)	(0.25)
Herfindahl index of employment	−0.16	−0.24
	(2.54)	(2.62)
Rent	0.03	0.02
	(0.50)	(0.31)
Government		
Local government public welfare expenditure (per capita)[b]	0.03	0.04
	(2.26)	(1.94)
Local government education expenditure (per capita)[b]	−0.13	−0.19
	(0.37)	(0.64)
Local government highway expenditure[b]	0.09	0.12
	(1.74)	(1.57)
Local government tax revenue (per capita)[b]	−0.06	−0.04
	(0.63)	(0.30)
Local government LR debt outstanding (per capita)[b]	0.06	−0.15
	(0.57)	(0.88)
State government highway expenditure	−0.02	−0.01
	(0.37)	(0.14)
Demographics		
Proportion on farm	−0.02	−0.02
	(1.23)	(0.98)
Proportion black	−0.01	−0.01
	(3.07)	(1.71)
Proportion less than 15 years old	0.04	−0.01
	(0.23)	(0.03)
Proportion 65 years and over	−0.04	−0.03
	(0.91)	(0.50)
F-value	21.9	26.8
N	1224	1224
R^2	0.42[c]	0.49[c]

Note: 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.

[a] t-values are in parentheses.

[b] Instrumented by the other regressors plus measures of start of period local teacher salary, percentage of low income families, cost of rural road construction, union density, land suitability for road construction, state tax collections per capita, and federal funds per mile of state roadway. All instruments are dated at the start of the decade.

[c] R^2 from the unrestricted form of the model.

younger workers because they have a longer time to recoup the costs of moving.[17]

Consistent with the migration theory framework, rural incomes have a positive, albeit only marginally significant impact on population growth. The estimated elasticity implies that a 10% increase in rural income will raise the rural working-age population by 1.7% and the young population by 2.3%.

The aggregate human capital effect, holding income constant, can be obtained by summing the coefficients on median school years completed and the percentage of population with a high school degree. The joint effect is −0.29 (t-statistic = 2.27) for the older working

[17] Mincer showed that migration rates decline as age increases.

Table 3. Neutrality Tests of Local Government Fiscal Policy

	Full County Population		Farm Population		Nonfarm Population	
Test: Neutrality of	Aged 20–64 years	Aged 20–34 years	Aged 20–64 years	Aged 20–34 years	Aged 20–64 years	Aged 20–34 years
A. Local government expenditure (welfare + education + highway)	−0.01[a] (0.01)[b]	−0.03 (0.14)	−0.88 (3.46)	−1.17 (3.44)	0.03 (0.14)	−0.088 (0.37)
B. Local government expenditure plus tax	−0.07 (0.71)	−0.07 (0.51)	−0.71 (4.29)	−0.88 (3.96)	−0.10 (0.84)	−0.17 (1.09)
C. Local government expenditure plus tax plus debt outstanding	−0.12 (0.69)	−0.22 (0.78)	−0.73 (3.57)	−0.94 (3.41)	−0.32 (2.17)	−0.47 (2.44)

[a] Elasticity of population growth with respect to the corresponding policy. The first two columns are based on the coefficients reported in table 2, while the last four columns are based on table 5. The effects are estimated by summing the coefficients on the policy variables in question. For example, the local government expenditure effect is estimated as the sum of the coefficients on welfare, education, and local highway.
[b] t-statistic of the restriction that the sum of coefficients equals zero.

age group and −0.46 (t-statistic = 2.42) for the younger working age group. The human capital measures imply that if rural income is held fixed, a 10% increase in human capital (equivalent to a simultaneous 10% increase in median school years and in the percentage with high school degrees) lowers the working age population by 2.9% and lowers the young working-age population by 4.6%.

However, that interpretation overstates the impact of human capital on rural outmigration because human capital also raises rural income which can reduce outmigration. The brain drain effect given by equation (9) can be estimated using the reduced form[18] of (8), which yields a direct estimate of $0.5\,\beta_1(\gamma_1^R - \gamma_1^U) = -0.19$ (t-statistic = 3.59) for the full working-age population and −0.26 (t-statistic = 3.44) for the young subset. The estimates imply that relative returns to human capital are higher in urban than in rural counties. This conclusion is supported by an auxiliary regression of (6A), which yields an estimate of γ_1^R, which is then applied with the estimate of β_1 to derive the value of γ_1^U. The auxiliary regression yielded an implied return to human capital of 0.346.[19] Therefore, the alternative estimate of (9) is $\gamma_1^R\,\beta_1 - 0.5\,\beta_1(\gamma_1^R + \gamma_1^U) = (0.17)(0.346) - 0.29 = -0.23$ for the full group and $(0.23)(0.346) - 0.46 = -0.36$ for the young working-age group. Both analyses imply brain drain from rural to urban counties for the best educated, with the largest effect among the young. Even though human capital raises the income an individual can earn in a rural market, it raises the income an individual can earn in an urban market even more.

Proximity to an urban area does not significantly change rural population growth. However, having a diverse labor market is important. A 10% increase in the Herfindahl index lowers the working age population by 1.6% and lowers the young working age population by 2.4%. This suggests that the rural population grows faster when residents can access a wide range of jobs. 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.[20]

Government tax and expenditure policies have various effects, although most are small and insignificant. Increased local welfare expenditure raises the population, but the effect is very small. Rural county road expenditures also appear to increase rural population growth rates modestly. 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 a 1% increase in all county government expenditures, a 1% increase in all county expenditures and taxes, and a 1% increase in all county expenditures, taxes, and debt. These

[18] The reduced-form regressions (available at http://www.econ.iastate.edu/faculty/orazem/) insert measures of H_t^R and X_t^R in place of Y_t^{RR} in (8).
[19] The auxiliary income equations are available at http://www.econ.iastate.edu/faculty/orazem/.
[20] Fawson, Thilmany, and Keith also found that diversified employment base was more favorable to long-term growth than concentrated employment in one or two sectors.

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

	Population Aged 20–64 years		Population Aged 20–34 years	
	Time Series[b] 1990–50	Cross-Section[c] 1950	Times Series[b] 1990–50	Cross Section[c] 1950
Income (+)[a]	−1.21	50.66	−1.65	69.14
Human Capital (−)	−16.18	−49.43	−20.98	−65.78
Distance to City (−)	–	−1.93	–	−3.32
Herfindahl Index (−)	5.41	−36.48	8.23	−55.47

[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.

estimates are made by summing the relevant fiscal policy coefficients from table 2. None of the local fiscal policy measures increases population growth. At best, the combined effects of county government tax and expenditure policies have neutral effects on rural working-age populations, and they may even have a small negative impact. Clearly, rural governments cannot expect to raise their populations by altering the provision of public services, government revenues, or the mix of current versus future financing.[21]

The demographic variables have virtually no effect on population growth rates. All coefficients are extremely small and most are not significant. Variation in rent also has an insignificant impact on rural population growth both numerically and statistically.

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 reported in table 4.

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 16%, other things equal, and decreased the young working-age population by almost 21%. 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 young working age population is more sensitive to variation in economic factors, with variation in rural income and human capital having the largest impacts. Rural income accounts for differences in population growth of 51–69%, depending on the age group. Variation in human capital stock can

[21] Wojan (p. 603) proposed that improving rural infrastructure was a sustainable mechanism for retaining high-skilled workers in rural areas, but results herein imply that improved government services will not help if the improvements are funded by local taxes. Using a different data set over the 1969–96 period, Khan, Orazem, and Otto also found that locally financed government services did not raise local populations.

account for differences of 49–66%. Herfindahl employment indices also make a big impact of 36–55% difference in population growth. Variation in proximity to a central city accounts for deviations of 2–3%. 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.

Rural and Nonfarm Population Growth

Because over half of farm income is earned off the farm,[22] 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 spill over to the nonfarm sector, maintaining nonfarm populations. This view has been challenged recently by Goetz and Debertin 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.[23] 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 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.[24] The farm income measure was not available directly. Instead, farm income was derived from aggregate county income minus aggregate nonfarm income and divided by farm population. Additional error measurement was introduced because of changing definitions of farms and of households. Because these measures of farm and nonfarm income are subject to multiple sources of measurement error, we use instrumental variable methods to identify farm and nonfarm incomes.[25] The instruments included those used in table 2 plus measures of farm capital stock (value of land and buildings per acre, average size of farm) and type of farm operation (share of crops in total farm production).[26]

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 one major difference in response to 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 and significant. This implies that increases in farm income lower the nonfarm population growth rate and increases in nonfarm incomes lower the farm population growth rate. Equiproportional increases to both farm and nonfarm incomes will raise the nonfarm population but lower the farm population.[27] This is consistent

[22] Ahearn, Perry, and El-Osta (p. 12).

[23] It is difficult to compare the results reported herein with those in Goetz and Debertin 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.

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

[25] 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.

[26] We lost twenty-one observations because of missing observations on farm income. An earlier version of this article applied two-stage least squares which allowed predicted farm income to be included for those counties as well. Qualitative conclusions were not affected.

[27] To derive these implications, add the coefficients on farm and nonfarm incomes. The sum is negative for the farm population and positive for the nonfarm population.

Table 5. Instrumental Variable Regressions of Rural Farm and Nonfarm Population Growth Rates in the Midwest and South, 1950–90 (All Variables in Natural Logarithms)

	Individuals Aged 20–64 years		Individuals Aged 20–34 years	
Explanatory Variables	Farm Population	Nonfarm Population	Farm Population	Nonfarm Population
Median farm income per person[b]	1.01 (7.17)[a]	−0.24 (2.40)	1.31 (7.01)	−0.12 (0.89)
Median nonfarm income per person[b]	−1.23 (5.68)	0.54 (3.56)	−1.50 (5.19)	0.46 (2.30)
Human Capital Median school years completed	−0.03 (0.12)	−0.10 (0.59)	−0.30 (0.96)	−0.30 (1.38)
Percentage of population with high school degree	0.04 (0.30)	−0.14 (1.43)	0.05 (0.29)	−0.10 (0.76)
Local Economy Distance to a city with population > 100,000	0.01 (0.40)	−0.02 (0.64)	0.03 (0.63)	−0.06 (4.00)
Herfindahl index of employment	−0.11 (1.17)	−0.11 (1.63)	−0.20 (1.64)	−0.029 (0.62)
Rent Government	0.26 (2.22)	−0.00 (0.05)	0.37 (5.54)	0.07 (1.52)
Local government public welfare expenditure (per capita)[b]	−0.01 (0.47)	0.03 (1.39)	−0.02 (0.43)	0.03 (1.05)
Local government education expenditure (per capita)[b]	−0.97 (3.41)	−0.10 (0.48)	−1.30 (3.45)	−0.25 (0.96)
Local government highway expenditure[b]	0.10 (1.69)	0.10 (2.25)	0.15 (1.93)	0.14 (2.47)
Local government tax revenue (per capita)[b]	0.17 (1.14)	−0.13 (1.20)	0.29 (1.46)	−0.08 (0.59)
Local government LR debt outstanding (per capita)[b]	−0.02 (0.23)	−0.22 (3.00)	−0.06 (0.43)	−0.30 (3.13)
State government highway expenditure	0.20 (2.82)	0.02 (0.76)	0.22 (2.37)	0.05 (0.80)
Demographics Proportion black	−0.01 (1.10)	−0.02 (2.96)	−0.01 (0.77)	−0.01 (1.87)
Proportion less than 15 years old	0.57 (2.56)	0.16 (1.05)	0.84 (2.85)	−0.032 (0.32)
Proportion 65 years and over	0.04 (0.42)	−0.01 (0.14)	0.07 (0.55)	−0.004 (0.08)
F-value	12.9	8.1	15.4	8.9
N	1203	1203	1203	1203
R^2	0.41[c]	0.32	0.44	0.34

Note: 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.

[a] *t*-values are in parentheses.

[b] Instrumented by variables in table 2 plus county measures of average farm size, percentage of farm revenue in crops, percentage of farm population and value of land and buildings per acre.

[c] From the unrestricted form of the model.

with cross-migration from the rural farm to the rural nonfarm sector as farm and nonfarm incomes have grown over the century.

As explained above, the coefficients on human capital do not yield the brain drain effect directly. Using the unrestricted form of (8), estimates of $0.5(\gamma_1^R - \gamma_1^U)$ were -0.01 (t-statistic $= 0.15$) for the farm population as a whole and -0.13 (t-statistic $= 1.87$) for the nonfarm population. The estimates grow in size and significance when considering only the young working age population: -0.25 (t-statistic $= 1.92$) for the young farm population and -0.2 (t-statistic $= 2.46$) for the young nonfarm population. Thus, we have identified two reasons for the outmigration of the young out of agriculture: the finding above that equiproportional increases in rural farm and nonfarm incomes will lead to exits from the farm sector, and the finding that the young farm population has a wider gap in urban-rural returns to human capital than either the older farm or the nonfarm populations.[28]

Increasing local rents raises the farm population growth rate while having neutral effects on the nonfarm population. If variation in rents reflects variation in property values, farmers who are landowners would benefit from the higher rental values.

Government policy effects are generally consistent between the farm and nonfarm sectors. The neutrality tests reported in table 3 show that both the farm and nonfarm working-age populations grow more slowly as locally financed government services are expanded.

Conclusions and Policy Implications

This study found strong support for using the human capital perspective in analyzing rural population growth. The empirical estimates show that human capital generates higher returns in urban than in rural areas. As a consequence, rural areas suffer from brain drain. Increased rural education levels have retarded rural population growth by 16–21% between 1950 and 1990. Counties with more highly educated populations experience population growth 49–66% slower than counties with the least educated populations. The young working-age population is particularly sensitive to economic incentives to move.

Changes in per capita rural income have had a modest effect on rural population growth. Over the 1950–90 period, there has been a small decrease in real rural per capita income which has led to a small decrease in average rural population. However, counties with the highest per capita income grew 51–69 % faster per decade than did the lowest income counties.

Counties with employment concentrated in only a few sectors grow more slowly. The slight increase in average rural employment diversification over time has contributed modestly to rural county population growth. The larger effect is across counties, where the most diversified counties have population growth rates 36–55% higher per decade than do the most concentrated counties.

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.

There is no evidence that rural investment in public services will attract new residents to rural areas. Local government provision of services funded by raising local taxes or issuing debt do not increase and may decrease rural population.

These results present a cautionary tale for public policy aimed at rural economic development. The finding that more diversified rural economies have faster population growth suggests that efforts to spur expansion of one or two sectors may weaken rather than strengthen the rural labor market. Rather than pick targeted sectors for subsidy, funds are better spent expanding the range of industries within commuting distance. One way to accomplish this is to improve local transportation, a finding consistent with the positive effects of local highway expenditures on local population growth in both tables 2 and 5.

The finding that farm incomes do not raise nonfarm populations and vice versa corroborates the findings of Goetz and Debertin. Political proponents of government agricultural

[28] 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 evidence that increased urban wages lead to larger scale operations. Gisser and Davila found similar results for the 1960s, but argued that the gap in urban wages and rural farm wages has shrunk since 1970.

subsidies frequently contend that farm incomes have strong multiplier effects in the nonfarm rural economy. These claims are not supported by the data.

Finally, this study illustrates the challenge that human capital presents to rural economic development. Increased educational attainment is strongly tied to increases in rural incomes, and yet the returns to those investments are higher in urban than in rural labor markets. In fact, higher local public expenditures on education also lower population growth in both tables 2 and 5 and significantly so for the farm population. Consequently improvements in human capital may be necessary to raise rural incomes, but those improvements may themselves lead to accelerated outmigration from rural counties.

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