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The determinants of rural population growth and decline, 1950-1990: the roles of government policy, human capital, and farm and nonfarm income

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The determinants of rural population growth and decline, 1950-1990: The roles of government policy, human capital, and farm and nonfarm income

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DEDICATION

This dissertation is dedicated with my greatest appreciation and affection to my mother, Chih-Chin, as a mother's day present and to the rest of my family: my father, Jeng-Ren, my brother, Jiung-Lin, and my sisters, Tzu-Long, Chun-Hua, Tzu-Hui. Their love, encouragement, and support helped me through my years of graduate study to make my dreams come true.

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ABSTRACT

In the past few decades, changes in economic conditions for off-farm labor markets and improvements in agriculture technology have led to substantial reductions in farm population in the United States. However, rural population are not decreasing uniformly, either across counties or over decades. Rates of change in farm and nonfarm populations vary widely across rural counties. The variation of population growth across counties and between farm and nonfarm population raise two questions in this study: (1) What affects the population growth and decline in US rural counties? (2) Do those factors affect farm and nonfarm populations differently?

This study is based on the human capital model of migration which emphasizes economic returns as the driving force for moves. For that reason, the study concentrates on individuals of working ages 20-64. Previous studies and human capital theory have shown that younger people have a greater incentive to move than older people. To focus on the population most sensitive to migration factors, the moves of a younger working age subgroup (individuals aged 20-34) are also examined.

The results show that human capital investment, average income, the diversity of industrial mix, and predicted per capita local government tax revenue are major determinants of rural county population changes. Rural county population growth is neutral toward self-financed increased local government services in both age group. Some major determinants of rural population growth, such as human capital, farm income, and local labor market conditions affect farm and nonfarm population differently. In addition, farm and nonfarm populations are sensitive to different local government policies.

CHAPTER 1. INTRODUCTION

In the past few decades, changes in economic conditions for off-farm labor markets and improvements in agriculture technology have led to substantial reductions in farm population in the United States. Table 1.1 shows the regional distribution of farm residents from 1950 to 1989. Although a change in the empirical definition of farm in 1980 contributed to the measured decline in farm population, the dramatic drop in farm population is clearly a real decline and not measurement error.

However, rural populations are not decreasing uniformly, either across counties or over decades. Rates of change in farm and nonfarm populations vary widely across rural counties. This study is based on the human capital model of migration which emphasizes economic returns as the driving force for moves. For that reason, this study will concentrate on individuals of working ages 20-64. Previous studies and human capital theory have shown that younger people have a greater incentive to move than older people. To focus on the population most sensitive to migration factors, the moves of a younger working age subgroup (individuals aged 20-34) are also examined. Rural counties in the Midwest and the South, which have an important agricultural base and standard geographical size, were selected for the study. Because of data availability on farm populations, only counties with farm population above 400 in 1960 were selected.

The means, minima, and maxima of rural county population growth rates in the Midwest and the South from 1950 to 1990 are shown in Table 1.2. Since there was a definition change of rural farm in the 1980 Census of Population, the rates of farm and nonfarm population change for the decade of 1970-1980 are estimated from special tabulations provided by the Bureau of Census[1].

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[1] Since the new definition of rural farm is consistent for the 1980 and 1990 Census, there is no problem computing changes in the farm and nonfarm populations for that period.

Table 1.1. Regional distribution of farm residents from 1950 to 1989 (Numbers in thousands)

Year	Total	Northeast	Midwest	South	West
Current farm definition[a]:					
1989	4,801	233	2,465	1,409	695
1980[b]	6,051	443	2,730	2,162	716
Previous farm definition:					
1980[b]	7,241	487	3,252	2,629	873
1970	9,712	699	4,305	3,754	954
1960	15,635	1,119	5,836	7,160	1,520
1950	23,048	1,791	7,433	11,896	1,929

Source: Figures for 1980 and early years are from the Current Population Report, population characteristics series P-20, No. 446, October 1990. Figures for 1989 are from the 1989 Residents of Farms and Rural Areas.

[a] The 1980 Census of Population: "The farm population is identified only in rural areas and includes all persons living on places of one acre or more from which at least $1,000 worth of agricultural products were sold during 1979. The definition of a farm has been changed since the 1970 Census, when a farm was defined as a place of 10 or more acres with at least $50 worth of annual sales or a place of under 10 acres with at least $250 worth of agricultural sales.

[b] The 1980 estimates are based on the population controls from the 1970 census and thus are not directly comparable to the estimates for later years.

Table 1.2. Means, minima, and maxima of rural county population growth rates in the Midwest and South, 1950-1990 (numbers in percentage)

	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

Table 1.2 shows that farm population has substantially decreased in rural counties since 1950; however, the decrease is not uniform across counties. Rural population increased in the 1960s and the 1970s due to increases in nonfarm populations which outweighed substantial reductions in farm populations. The increase in rural population slowed in the 1980s. The variation of ten-year population growth across counties and between the farm and nonfarm sectors raise two questions: (1) What affects the population growth and decline in US rural counties? (2) Do those factors affect farm and nonfarm populations differently?

In the first section, the rationale for using the county rather than the state as the geographical unit of observation is discussed. Patterns of rural county population change from 1950 to 1990 are presented in the second section. A literature review and expected outcomes of the study are presented in the last two sections.

County vs. State as a Geographical Unit

Tarver and Gurley (1965) state that,

> Obviously, the intercensal net migration rate of counties are much more variable than those for states. Small political subdivisions, such as counties, are apparently much more sensitive to short-term fluctuations and react much more suddenly than larger areas such as states to marked economic changes and other factors which stimulate or protract short-run population growth. (p. 12)

Nevertheless, most migration studies have concentrated on bigger geographical units, such as states, SMSAs, census regions, or entire nations. A summary of geographical units used in previous studies is shown in Table 1.3. Four of the articles used counties as the unit of observation. Sandell (1977) used micro data to explain five-year family migration across counties or SMSAs. Rutman (1970) used counties and economic areas of West Virginia as geographical units to explain the relationship between change in economic opportunity and population movements. The other two county migration

Table 1.3. Geographical units and data types of analysis in previous migration studies and in this study

Studies	Geographical unit	Data type
Tarver and Gurley (1965)	County	Macro data
Rutman (1970)	County and Region	Macro data
Schwartz (1970)	Region	Macro data
Cebula (1974)	State	Macro data
Graves (1977)	SMSA	Macro data
McCarthy and Morrison (1977)	County	Macro data
Sandell (1977)	County/SMSA	Micro data
Nakosteen and Zimmer (1980)	State	Micro data
Milne (1981)	Census region	Macro data
Schlottmann and Herzog (1981)	State	Micro dada
Barkley (1990)	Nation	Macro data
This study	County	Macro data

studies are Tarver and Gurley (1965) and McCarthy and Morrison (1977). The former focused on the relationship of income, human capital, and percent of employment in construction to net county migration during the 1950s, while the latter examined the post-1970 reverse movement from urban to rural areas.

Those county migration studies either concentrated on only a single state or a short period of time. This dissertation focuses on rural county population changes in the Midwest and in the South during 1950-1990. As shown in Table 1.2, population growth rates varied widely across counties. To formally test the county vs. state variation on county population change during the period studied, an analysis of variance (ANOVA) is performed.

Analysis of variance of population growth, county vs. state

Groshen (1991) used ANOVA procedures to explain the sources of intra-industry wage dispersion. She partitioned the variance of wages into three sources by using vectors of occupational dummies, establishment dummies, and dummies of their interaction. Following Groshen's method, three sources of population growth dispersion are considered in the ANOVA: state, county, and time.

Partition the variance of county population growth into state and county by using a vector of state dummy variables for each decade to prevent the effect of time differences. That is, the ANOVA of county population growth for each decade can be derived by

$$M_{ij} = \mu + S_i + \varepsilon_{ij} \qquad (1.1)$$

where, M_{ij} is population growth in county j and state i, μ is the average population growth, S_i is a vector of 16 state dummies for 17 states, and ε_{ij} is an error term[2].

[2] Unlike the variance of wages between establishments and occupations in Groshen (1991), there is no interaction effect between states and counties. For example, the variance of

Since state and county are the two sources of the variation of county population change in equation (1.1), the error term of the equation indicates county variation. The ANOVAs of equation (1.1) are presented in Table 1.4. The R^2s show that only 8-28 percent of the variance of county population growth over a decade can be explained by the state dummy variables. The remaining unexplained variation is attributable to county variation.

A second partition of the variance of county population growth from 1950 to 1990 into state, county, and time is,

$$M_{ijk} = \mu + S_i + C_{ij} + T_k + \varepsilon_{ijk} \qquad (1.2)$$

where, M_{ijk} is population change in county j, state i during the decade k, C_{ij} is a vector of county dummies, and T_k is a vector of time dummy variables. In contrast, another possible regression is:

$$M_{ijk} = \mu + S_i + T_k + \varepsilon_{ijk} \qquad (1.3)$$

The ANOVAs of equations (1.2) and (1.3) are presented in Table 1.5. The R^2s show that 29 percent (0.49 - 0.20) more of the variance of county population growth is explained by the county dummy variables.

Therefore, state-level variables can explain only a small portion of the variation in population growth. County-level variables are needed to explain the balance of the variation.

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population growth in Shannon, SD during 1950-1960 does not interact with that in Story, Iowa during the same period as the variance of secretary wages in hospitals do with the variance of those in schools.

Table 1.4. Analysis of variance of county population growth by decade, county vs. state

Dependent variable	Source	DF	Sum of Square	F value	Pr > F
Pop growth rate, 1950-1960	Model	16	18488.38	1.56	0.0797
	Error	289	214469.43		
	Corrected Total	305	232957.81		
			Anova Sum of Square		
	State	16	18488.38	1.56	0.0797
	R-square: 0.08				
Pop growth rate, 1960-1970	Model	16	22743.67	3.60	0.0001
	Error	289	114040.01		
	Corrected Total	305	136783.68		
			Anova Sum of Square		
	State	16	22743.67	3.60	0.0001
	R-square: 0.17				
Pop growth rate, 1970-1980	Model	16	22235.72	6.99	0.0001
	Error	289	57442.68		
	Corrected Total	305	79678.40		
			Anova Sum of Square		
	State	16	22235.72	6.99	0.0001
	R-square: 0.28				
Pop growth rate, 1980-1990	Model	16	14441.37	5.65	0.0001
	Error	289	46174.34		
	Corrected Total	305	60615.71		
			Anova Sum of Square		
	State	16	14441.37	5.65	0.0001
	R-square: 0.24				

Table 1.5. Analysis of variance of county population growth, county vs. state

Dependent variable	Source	DF	Sum of Square	F value	Pr > F
Pop growth rate, 1950-1990	Model	308	283371.52	2.89	0.0001
	Error	915	290894.13		
	Corrected Total	1223	574265.65		
			Anova Sum of Square		
	State	16	51471.70	10.12	0.0001
	County (State)	289	167669.78	1.82	0.0001
	Time	3	64230.04	67.34	0.0001
	R-square: 0.49				
Pop growth rate, 1950-1990	Model	19	115701.74	15.99	0.0001
	Error	1204	458563.91		
	Corrected Total	1223	574265.65		
			Anova Sum of Square		
	State	16	51471.70	8.45	0.0001
	Time	3	64230.04	56.21	0.0001
	R-square: 0.20				

Patterns of Rural County Population Growth from 1950 to 1990 (Census Data)

Means of population growth rates are presented in Table 1.6-Table 1.9 sorted by the percentage of farm population in 1950, the distance from the center of a rural county to its nearest big city (defined as a city with 25, 000 or more residents in 1950), the percentage of blacks in total population in 1950, and the percentage of population with high school degree in 1950.

As shown in Table 1.6, county population changes in the 1950s and the 1960s were inversely related to the percentage of farm population in 1950 (PF). However, county population changes in the 1970s and the 1980s did not vary with percentage of farm population. Moreover, the counties in the upper quartile of PF in 1950 had the highest rates of nonfarm population growth in all decades. Nevertheless, over the full forty year period, rural counties that had the smallest proportion of their populations on farms grew the fastest. Despite their relatively rapid growth in nonfarm populations, the counties with heavy farm concentrations also faced relatively large outflows from their farm populations which limited their overall population growth.

Table 1.7 shows that the distance from the center of a rural county to its nearest city with population at least 25,000 in 1950 (DS) were related to county and nonfarm population growth rates. Counties in the lowest distance quartile in 1950 had the highest population growth rates, while counties in the highest distance quartile had the lowest population growth rates. The pattern holds in every decade. The least remote counties gained 56 percent in population over the forty years, while the most remote counties lost 11 percent in population. The gap in population growth of 20-34 year-olds between the least and most remote counties is even larger.

The means of population growth rates by the percentage of blacks in total population in 1950 (BK) are presented in Table 1.8. Basically, the rural counties in the lowest

Table 1.6. Means of the population growth rates, by the percentage of farm population of 1950 (PF) (numbers in percentage)

	Individuals aged 20-64			Individuals aged 20-34		
	County	Farm	Nonfarm	County	Farm	Nonfarm
1950-60						
PF < Q1[a]	-3.97	-40.62	9.78	-14.66	-54.66	-1.88
Q1 ≤ PF< Med[b]	-4.72	-40.09	20.20	-10.25	-55.18	16.99
Med ≤ PF< Q3[c]	-13.41	-34.84	8.37	-27.03	-50.63	-5.49
PF ≥ Q3	-15.43	-38.40	32.27	-30.73	-54.87	14.20
1960-70						
PF < Q1	4.34	-28.12	11.23	9.91	-34.90	17.57
Q1 ≤ PF< Med	5.55	-30.21	17.46	18.16	-31.86	30.45
Med ≤ PF< Q3	1.66	-30.26	18.78	7.47	-37.40	28.61
PF ≥ Q3	-0.95	-33.95	27.23	4.15	-38.87	34.30
1970-80						
PF < Q1	10.93	-12.06	15.10	10.93	-12.06	13.63
Q1 ≤ PF< Med	9.85	-15.39	16.96	9.84	-15.43	15.44
Med ≤ PF< Q3	10.85	-13.52	21.62	10.85	-13.52	18.50
PF ≥ Q3	12.71	-20.14	31.47	12.70	-20.17	26.66
1980-90						
PF < Q1	1.13	-25.73	4.72	-9.43	-23.61	-7.08
Q1 ≤ PF< Med	2.12	-29.50	7.96	-8.37	-31.28	-4.74
Med ≤ PF< Q3	0.39	-34.97	8.78	-7.73	-39.37	-1.60
PF ≥ Q3	2.62	-32.72	11.68	-3.31	-31.98	3.05
1950-90						
PF < Q1	33.07	.	.	32.82	.	.
Q1 ≤ PF< Med	25.04	.	.	32.75	.	.
Med ≤ PF< Q3	12.83	.	.	14.45	.	.
PF ≥ Q3	7.79	.	.	6.31	.	.

[a] Q1 is the lower quartile of PF.

[b] Med is the median of PF.

[c] Q3 is the upper quartile of PF.

Table 1.7. Means of the population growth rates, by the distance of the center of a county to its nearest city with more than 25,000 population of 1950 (DS) (numbers in percentage)

	Individuals aged 20-64			Individuals aged 20-34		
	County	Farm	Nonfarm	County	Farm	Nonfarm
1950-60						
DS < Q1[a]	-1.71	-35.51	22.45	-11.21	-50.76	13.21
Q1 ≤ DS< Med[b]	-11.02	-42.64	17.77	-24.24	-57.38	2.72
Med ≤ DS< Q3[c]	-8.33	-42.30	27.45	-16.09	-58.31	19.69
DS ≥ Q3	-16.01	-33.43	2.14	-30.77	-48.69	-12.78
1960-70						
DS < Q1	9.59	-28.34	25.03	18.46	-29.68	34.59
Q1 ≤ DS< Med	2.08	-31.27	17.10	10.61	-36.09	27.69
Med ≤ DS< Q3	5.16	-35.27	24.60	18.70	-38.52	37.90
DS ≥ Q3	-5.99	-27.21	7.45	-8.12	-38.30	9.99
1970-80						
DS < Q1	14.22	-11.01	21.80	14.22	-11.01	19.49
Q1 ≤ DS< Med	11.83	-12.59	19.43	11.84	-12.63	16.94
Med ≤ DS< Q3	13.84	-13.38	24.18	13.84	-13.41	21.14
DS ≥ Q3	4.42	-23.76	19.16	4.41	-23.77	16.21
1980-90						
DS < Q1	6.50	-29.06	11.69	-2.28	-25.78	0.77
Q1 ≤ DS< Med	1.47	-30.83	7.33	-6.71	-33.22	-2.76
Med ≤ DS< Q3	2.00	-29.10	7.90	-7.52	-28.60	-3.61
DS ≥ Q3	-3.57	-33.73	6.16	-12.24	-38..38	-4.84
1950-90						
DS < Q1	55.89	.	.	60.71	.	.
Q1 ≤ DS< Med	14.73	.	.	18.08	.	.
Med ≤ DS< Q3	20.86	.	.	25.41	.	.
DS ≥ Q3	-10.92	.	.	-16.04	.	.

[a] Q1 is the lower quartile of DS.

[b] Med is the median of DS.

[c] Q3 is the upper quartile of DS.

Table 1.8. Means of the population growth rates, by the percentage of blacks in total population of 1950 (BK) (numbers in percentage)

	Individuals aged 20-64			Individuals aged 20-34		
	County	Farm	Nonfarm	County	Farm	Nonfarm
1950-60						
BK < Q1[a]	-13.77	-28.70	2.64	-27.31	-45.30	-8.91
Q1 ≤ BK< Med[b]	0.86	-33.92	26.79	1.00	-47.79	30.70
Med ≤ BK< Q3[c]	-10.37	-39.61	16.27	-22.84	-56.25	3.02
BK ≥ Q3	-8.84	-53.17	32.43	-23.15	-66.41	12.30
1960-70						
BK < Q1	-3.80	-24.94	11.22	-2.11	-32.77	18.01
Q1 ≤ BK< Med	4.18	-24.19	16.78	8.95	-30.96	23.85
Med ≤ BK< Q3	2.92	-28.02	16.72	9.84	-30.15	22.64
BK ≥ Q3	9.97	-44.74	31.25	26.48	-48.40	47.70
1970-80						
BK < Q1	6.13	-20.87	21.34	6.12	-20.90	17.87
Q1 ≤ BK< Med	12.94	-15.41	22.35	12.94	-15.44	20.06
Med ≤ BK< Q3	13.24	-8.22	21.41	13.23	-8.19	18.84
BK ≥ Q3	14.16	-14.90	20.04	14.16	-14.95	17.92
1980-90						
BK < Q1	-3.04	-32.74	6.08	-13.86	-40.34	-7.80
Q1 ≤ BK< Med	2.11	-32.93	8.84	-7.89	-36.33	-2.82
Med ≤ BK< Q3	3.36	-31.44	10.57	-3.19	-32.82	2.27
BK ≥ Q3	5.39	-25.75	8.30	-2.31	-15.28	-0.85
1950-90						
BK < Q1	-2.95	.	.	-2.95	.	.
Q1 ≤ BK< Med	43.68	.	.	51.07	.	.
Med ≤ BK< Q3	20.07	.	.	20.64	.	.
BK ≥ Q3	34.37	.	.	36.61	.	.

[a] Q1 is the lower quartile of BK.

[b] Med is the median of BK.

[c] Q3 is the upper quartile of BK.

Table 1.9. Means of the population growth rates, by the percentage of total population of 1950 with high school degree (HS) (numbers in percentage)

	Individuals aged 20-64			Individuals aged 20-34		
	County	Farm	Nonfarm	County	Farm	Nonfarm
1950-60						
HS < Q1[a]	-12.44	-50.86	35.49	-27.98	-65.21	13.85
Q1 ≤ HS< Med[b]	-5.96	-42.39	27.49	-12.97	-57.66	22.31
Med ≤ HS< Q3[c]	-13.85	-32.16	-0.85	-26.61	-47.91	-13.17
HS ≥ Q3	-4.91	-28.49	7.77	-14.52	-44.45	0.48
1960-70						
HS < Q1	7.82	-39.77	31.15	21.59	-42.52	44.65
Q1 ≤ HS< Med	5.40	-33.08	24.09	14.38	-37.80	34.16
Med ≤ HS< Q3	-2.43	-27.09	9.90	2.22	-34.36	19.37
HS ≥ Q3	-0.14	-22.36	9.03	1.44	-28.22	12.10
1970-80						
HS < Q1	17.80	-12.25	29.26	17.79	-12.31	26.05
Q1 ≤ HS< Med	15.73	-11.66	24.40	15.72	-11.65	21.63
Med ≤ HS< Q3	7.10	-16.47	19.07	7.10	-16.49	16.29
HS ≥ Q3	3.66	-20.49	12.00	3.66	-20.49	9.92
1980-90						
HS < Q1	5.35	-23.97	10.14	-0.08	-14.16	2.74
Q1 ≤ HS< Med	5.57	-30.84	11.77	-2.58	-31.42	1.38
Med ≤ HS< Q3	-2.13	-32.17	5.62	-11.77	-38.28	-5.76
HS ≥ Q3	-2.56	-35.83	5.45	-14.57	-42.46	-8.99
1950-90						
HS < Q1	27.48	.	.	26.91	.	.
Q1 ≤ HS< Med	35.28	.	.	43.27	.	.
Med ≤ HS< Q3	0.96	.	.	3.86	.	.
HS ≥ Q3	15.75	.	.	13.20	.	.

[a] Q1 is the lower quartile of HS.

[b] Med is the median of HS.

[c] Q3 is the upper quartile of HS.

quartile in 1950 had the lowest county and nonfarm population growth rates. However, the counties in the upper quartile in 1950 lost the most farm population in the 1950s, 1960s,and 1980s. Overall, changes in nonfarm populations were more important. The least black counties lost population, while the rest gained.

As indicated in Table 1.9, population changes were related to the percentage of population with high school degree in 1950 (HS). The counties with the percentage of high school graduates in the upper quartile had the lowest rates of county population decline in the 1950s. Counties in the upper half of high school recipients had the lowest population growth rates in the decades of 1960s, 1970s, and 1980s. The adverse effect of education on population growth is greatest for the nonfarm populations. The effect of education on farm population growth is positive in the 1950s and the 1960s. Counties with higher education level had lower rates of population decline. However, the positive effect of education on farm population growth is reversed in the 1970s and the 1980s. Over the forty years, counties in the lower half of high school graduates grew 2-3 times faster than those in the upper half.

Literature Review

Economists have studied migration for several decades. Most studies relate migration behavior to economic opportunity in an area. If an area with better economic opportunity or highly expanding economic conditions, the area is expected to attract populations. On the other hand, if an area lacks economic opportunity, then the area is expected to lose population. Average income (wages), employment rate, and unemployment rate are usually used as indicators of economic opportunity in an area. Rutman (1970) measured economic opportunities by the net change in unemployed, net change in employment, net change in nonagriculture employment, and net changes in employment in major industries (mining, manufacturing, construction, and service). He found that unemployment has no significant effect on net (in-) migration. However, net migration has a positive relationship with other measures of economic opportunity. Mead (1982) used wage growth, absolute wage, the relative local wage to SMSA wage, employment growth in agriculture, employment growth in nonagriculture, and unemployment as measures of economic opportunity in nonmetropolitan areas. He found out that the three wage measures were all positively related to rate of in-migration in nonmetropolitan areas, but negatively related to rate of out-migration in those areas. Employment growth in agriculture is positively related to the rate of in-migration but negatively related to the rate of out-migration in nonmetropolitan areas. Employment growth in nonagriculture has a negative but insignificant effect on the rate of out-migration in those areas, while unemployment has no significant effect on either rate of in-migration or rate of out-migration in nonmetropolitan areas.

The impact on migration of personal characteristics, such as education, age, sex, or race, are also commonly studied. Less frequently, government policy, climate, and marital status are included in migration articles. Table 1.10 provides a summary of the factors included in previous migration studies and the variables included in this study.

Young people are expected to be relatively more mobile because the young population have longer life to recover moving cost. Tarver and Gurley (1965) and Rutman (1970) showed a decline in net (in-) migration rate is associated with an increase in the proportion of youths. Consistent with earlier studies, age was negatively related to migration in Schlottmann and Herzog (1981). Cebula (1974) found different migration patterns for younger groups than for older groups. Significant negative unempolyment effect and significant positive income effect on net in-migration of young people are insignificant for the elderly.

Table 1.10. Determinants of migration in previous studies and this study[a]

Variables	Tarver and Gurley (1965)	Rutman (1970)	Schwartz (1970)	Muth (1971)	Speare (1971)	Cebula (1974)
Education	xx	..	xx	..	..	..
Age	xx	xx	xx	..	..	xx
Race	xx	..	..	..	..	xx
Sex	..	..	..	..	..	xx
Employment	..	xx	..	..	..	..
Unemployment	..	xx	..	xx	xx	xx
Present of dependents	xx	..	..	..	..	..
Income (Wage)	xx	..	..	xx	xx	xx
Industry related variables	xx	xx	..	..	..	..
Government policy	..	..	..	..	..	xx
Distance related variables	..	..	xx	..	..	..
Agriculture related variables	..	..	..	..	..	..
Amenity (Climate)	..	..	..	..	..	..

[a] The sign "xx" means that the variable has been incorporated in the corresponding migration study.

Table 1.10. (Continued)

Variables	Greenwood (1975)	McCarthy and Morrison (1977)	Sandell (1977)	Steinnes (1978)	Graves (1979)	Nakosteen and Zimmer (1980)
Education	xx	..	xx	..	..	..
Age	xx	..	xx	..	xx	xx
Race	..	..	..	xx	xx	xx
Sex	..	..	xx	..	..	xx
Employment	xx	..	..	..	..	xx
Unemployment	xx	xx	..	xx	xx	..
Present of dependents	..	..	xx	..	..	..
Income (Wage)	xx	xx	..	..	xx	xx
Industry related variables	..	..	..	..	..	..
Government policy	..	..	..	..	..	..
Distance related variables	..	..	..	xx	..	..
Agriculture related variables	..	..	..	..	..	..
Amenity (Climate)	..	xx	..	..	xx	..

Table 1.10. (Continued)

Variables	Milne (1981)	Schlottmann and Herzog (1981)	Mead (1982)	Barkely (1990)	Shields and Shields (1993)	This study
Education	..	xx	xx	..	xx	xx
Age	..	xx	..	..	xx	xx
Race	..	..	xx	..	..	xx
Sex	..	..	..	..	xx	..
Employment	..	xx	xx	..	..	..
Unemployment	xx	xx	xx	xx	..	..
Present of dependents	..	..	..	..	..	xx
Income (Wage)	xx	xx	xx	xx	xx	xx
Industry related variables	..	..	..	..	..	xx
Government policy	..	xx	..	xx	..	xx
Distance related variables	..	xx	xx	..	..	xx
Agriculture related variables	..	..	xx	xx	..	xx
Amenity (Climate)	..	xx	..	..	xx	xx

Nonwhite populations are assumed to have different migration pattern from whites. Cebula (1974) found that welfare benefits in an area are positively related to net in-migration of nonwhites, but negatively related to net in-migration of whites. He also found that state and local property tax levels have a negative effect on net in-migration of whites, but have no significant effect on net in-migration of nonwhites. Mead (1982) concluded that the percentage of nonwhite population in nonmetropolitan area is positively related to the rate of out-migration.

Highly educated people are assumed to have more chance to find jobs in any areas, thus are assumed to have more incentive to move. Sandell (1977) found that husband's education is positively related to family migration. A positive relationship between years of education and migration were found in Schlottmann and Herzog (1981). Moreover, Mead (1982) concluded that an increase in median school years completed in a region is associated with an increase in the rate of out-migration in the region.

In order to explain the phenomenon of the reduction of farm employment during 1940-1985, Barkley (1990) constructed an occupational migration model of agricultural and nonagricultural workers in the United States. He defined occupational migration as the percentage change in agricultural employment from one year to the next. Using a semilogarithmic migration function, he concluded that the higher the ratio of nonfarm returns to farm returns, the higher the ratio of nonfarm labor force to farm labor force. Lower real land prices also led labor to leave agriculture. Government payments did not have a significant effect on migration, but may affect occupational migration indirectly through their effects on farmland price.

Applying consumption theory, Graves (1979) interpreted migration as changing demand for location-specific goods. People will relocate their residence when relative prices and incomes change. In order to capture the life-cycle aspect of migration behavior of whites and nonwhites, Graves disaggregated migration by age and race.

Unemployment rate has a significant negative effect on net migration (net in-migration), while median income has a significant positive effect on net migration. The impact of economic opportunity (unemployment rate and median income) on migration was larger when climate variables were included in the model. White migration depended more strongly on employment opportunities, while nonwhites were more sensitive to income. The effects were most pronounced in samples of younger workers.

Schwartz (1976) used the shape of the earning-age function and education to explain the rate of migration (out-migration). The empirical results supported his proposition that migration declines with age at a rate that increases with education. That is, the rate of migration for any age category increases with education, but the rate of migration declines more rapidly with age as education increases.

Using Hazard model, Shields and Shields (1993) analyzed U.S. family migration during 1980-1985. The results of all moves, moves within a state, and moves between states were consistent. Both husband's and wife's education have a positive relationship with family migration. Husband' income and wife's wage in current location are negatively related to family migration. The presence of close friends or relatives in current location and in destination were used as amenity variables. The presence of close friends or relatives in current location decreases family migration, but that in destination encourages family migration.

Schlottmann and Herzog (1981) asserted that migration propensity is not the same between the employed and the unemployed. They also asserted that repeated migrants have higher incentive to move than primary migrants. Thus, the migration were examined, by employment status and by prior mobility, in four groups. Besides age and education, welfare service and real wages were considered in the study. Schlottmann and Herzog concluded that the possibility of migration of the unemployed is not decreased by the relatively high welfare service. Higher wages reduce the moves of the potential repeat migrants in an area. However, high wages in an area do not reduce the moves of the unemployed primary migrants.

Expected Outcomes

In the study, we expect to determine the factors that affected rural population growth and decline from 1950 to 1990 and to determine if these factors affect farm and nonfarm populations differently. In particular, we would like to know the roles that government policy, human capital, and farm and nonfarm income have. The study also will establish whether government policy can affect rural development and population growth.

CHAPTER 2. HYPOTHESES AND THEORETICAL FRAMEWORK

Hypotheses

The definition of migration varies in the literature. In order to prevent unnecessary confusion, define out-migration (migration) for county X as moving from county X to another county, in-migration for county X as moving from another county into county X, and net migration for county X as in-migration minus out-migration for county X.

In theory, the more highly educated an individual is, the greater are potential employment options, so it becomes generally easier to find a job. Thus, the well-educated have more tendency to move than others. Many studies have asserted the positive relationship between education and migration. Sandell (1977) showed that higher level of education for the husband induced a higher probability of family migration. Tarver and Gurley (1965) found that median years of schooling and the percent completing four or more years of high school had a negative relationship with net county migration rates.

It is possible that increased education levels accelerate the out-migration from rural areas. If urban labor markets offer better opportunities for educated labor, then rural counties will experience "brain drain." Thus, the first hypothesis is

Hypothesis 1: Suppose rural-urban income differentials for new urban migrants increase as years of education increases. Then rural human capital investments will be positively related to out-migration and negatively related to rural population growth.

Income is often considered in migration research. Income or a change in earning prospects at the origin relative to other places play an important role in predicting the net benefit from moving. If average income in a county is low relative to other counties or urban areas, holding general human capital characteristics fixed, its residents would expect a higher net return from moving. The second hypothesis is

Hypothesis 2: A rural county will lose population if average income in that county is low relative to other rural counties and urban areas, holding general human capital characteristics fixed.

Local tax and government debt outstanding represent part of residents' current and future financial obligations. Increased taxes would lower incentives to stay in an area. However, the more taxes local governments collect from their residents or the more debt they issue, the more public services the local governments can provide to their residents. Better local government services would be an incentive to remain. To the extent that local government services are paid for by local taxes, government policies regarding tax and expenditure will cancel out. Thus, the next hypothesis is

Hypothesis 3: Local government policy have no impact on migration decisions or population growth.

Big cities have large labor markets and more income opportunities. Big cities generally also have higher concentrations of food processors and other demanders of agriculture products. If the distance between a rural county and its nearest big city is small, the costs of commuting job search or of shipping agriculture products from the rural county to the big city will be small. Thus, the residents in that rural county do not have to move to reap the benefits of urban markets. Therefore, we have

Hypothesis 4: Population increases in a rural county as the distance from the county to its nearest big city decreases.

A county with a more diversified industrial mix can react more easily to industry-specific shocks, assuming there is no restriction on job switching between industries. Workers displaced from one industry will have many other local options. On the other hand, displaced workers in counties with only one local industry will have to seek employment elsewhere. So, we have

Hypothesis 5: Counties with more diversified industrial mix should be associated with higher population growth rate relative to counties with more industrial concentration.

Theoretical Framework

Assume individuals have a utility function of the form

$$U = U(X,L), \qquad \partial U/\partial X \geq 0,\ \partial U/\partial L \geq 0 \qquad (2.1)$$

where X is a vector of consumption goods and L is leisure time of individuals. Both the farm and nonfarm population, face two constraints, a budget constraint and a time constraint. That is,

$$PX = W_f N_f + W_{of} N_{of} + V = Y \qquad (2.2)$$

$$T = L + N = L + N_f + N_{of} \qquad (2.3)$$

where

P = a vector of prices corresponding to X,

W_f, W_{of} = the wage rates of farm and off-farm works, respectively,

N = time spent on work,

N_f, N_{of} = time worked on farm and off-farm, respectively,

L = time spent on leisure,

V = asset incomes,

Y = total income,

T = total available time of individual.

Assuming an individual j in a rural county A is considering a move to an urban area B in year t = k and that he plans to retire at age Q.

$$O_j = \sum_{t=k}^{Q} \left\{ \frac{U_{Bj}(X_B(t), L_B(t)) - U_{Aj}(X_A(t), L_A(t)) - C_j(t)}{(1+r)^{t-k}} \right\} \qquad (2.4)$$

where the first subscript on each variable is an index of places and the second subscript is an index of individuals. For simplicity, utility functions are discounted by the constant rate, r. The costs, both pecuniary and nonpecuniary of moving from rural county A to urban county B in year t are $C_j(t)$. Individual j will move to B, if $O_j > 0$; otherwise, he will stay in county A.

Assuming risk neutrality and a common labor supply decision in A and B, the positive relationship between income and utility allow us to restate individual j's objective as

$$NB_j = \sum_{t=k}^{Q} \left\{ \frac{Y_{Bj}(t) - Y_{Aj}(t) - C_j(t)}{(1+r)^{t-k}} \right\} \qquad (2.5)$$

Thus, individual j will migrate to B, if $NB_j > 0$; otherwise, he will stay in county A. Following Barkely (1990) define an index function, f_j, for aggregating individual migrants. That is,

$NB_j f_j \geq 0$, where

$$f_j = \begin{cases} 1 \text{ if } NB_j > 0 \text{ (migration occurs)} \\ 0 \text{ if } NB_j \leq 0 \text{ (migration does not occur)} \end{cases} \qquad (2.6)$$

According to Barkely (1990), the gross rate of out-migration from rural county A to urban county B, OM_{AB}, will be the sum f_j over the total population in county A[3]. That is,

[3] Urban county B may vary with different individuals.

$$OM_{AB} = \sum_{j=1}^{J} f_j \quad , \quad J = \text{total population in county A} \tag{2.7}$$

Thus, net migration (in-migration minus out-migration) into county A will be

$$M_A = IM_{AB} - OM_{AB} \tag{2.8}$$

where, IM_{AB} is the gross rate of in-migration into rural county A from urban county B. Population change in county A (ΔPOP_A), then, will be

$$\Delta POP_A = M_A + \text{error term} \tag{2.9}$$

The error term will include births and deaths in county A. In the empirical model, some of the error will be captured by age structure variables.

CHAPTER 3. EMPIRICAL SPECIFICATION

Population change in a county is influenced by net migration, births, and deaths in the county. In order to concentrate on population change due to job search and to ignore measurement errors due to births and deaths, this study is focused on the changes of working age populations aged 20-64 and aged 20-34. Because of data availability, ten-year population growth rates will be used as dependent variables instead of net migration rates. However, older populations will have more deaths, while younger populations should have more births than average. The percentage of population less than 15 years old and the percentage of population of ages 65 and over are used to correct for some error of using population growth rates as dependent variables.

Model specification is discussed in the first section. The second section contains a brief data description. The sample selection procedure is presented in the last section.

Specification of Models

The determinants of rural population growth and decline from 1950 to 1990 are the subject of this study. Of special interest are the roles that government policy, human capital, and farm and nonfarm income have on the population change. For empirical analysis, define net county migration or county population growth from year t-10 to year t as

$$M_c(t,\ t\text{-}10) = \ln\ N_c(t) - \ln\ N_c(t\text{-}10) \qquad (3.1)$$

where, t is year 1960, 1970, 1980, or 1990, and $N_c(t)$ is county population aged 20-64 (20-34) in year t. This study is also interested in the different migration behaviors (population growth) of rural farm and rural nonfarm populations.

Population growth in rural farm and rural nonfarm sectors from year t-10 to year t are defined as:

$$M_F(t,t\text{-}10) = \ln N_F(t) - \ln N_F(t\text{-}10) \quad (3.2)$$

$$M_{NF}(t,t\text{-}10) = \ln N_{NF}(t) - \ln N_{NF}(t\text{-}10) \quad (3.3)$$

where, t is year 1960, 1970, 1980, or 1990, $N_F(t)$ is county farm population aged 20-64 (20-34) in year t, and $N_{NF}(t)$ is county nonfarm population aged 20-64 (20-34) in year t.

Since the study concentrates on rural counties, county population will equal the sum of the rural farm and rural nonfarm populations. The terms "farm" and "nonfarm" instead of "rural farm" and "rural nonfarm" will be used, hereafter.

Expected net return to migration (NR) is a critical factor in economic models of migration. Define NR as expected income of the average rural county resident if he moves ($EY_{U,R}$) minus the actual average income at the origin (Y_R). That is,

$$NR \equiv EY_{U,R} - Y_R \quad (3.4)$$

In order to estimate NR, expected income from moving needs to be predicted. For simplicity, assume that the decision of a rural resident is whether to stay, or to move to urban area, U. In fact, the model is generalizable to expected returns to migration to all destinations.

Average income at area i is determined by a vector of human capital investment at area i (H_i), and by a vector (Z_i) of local labor market conditions and other location-specific characteristics at area i, such as weather and cost of living. Income at U can be expressed as the regression,

$$Y_U = \beta_{OU} + H_U\beta_U + Z_U\xi_U + \varepsilon_U \quad (3.5)$$

where β_{OU}, β_U, and ξ_U are parameters and ε_U is an error term with zero mean. Expected income at U for a resident of rural area, R, based on observed returns to human capital and local characteristics at U is

$$EY_{U,R} = \beta_{OU} + H_R\beta_U + Z_U\xi_U \tag{3.6}$$

Because EY_U excludes ε_U, ε_U is not in the error term of (3.6). Although the observed returns to human capital and local characteristics at U are fixed across counties at any point in time, human capital varies among rural counties. Equation (3.6) allows us to use cross-section variation in human capital to control for variation in returns to urban migraiton.

According to the consideration of the exogeneity of rural income, two cases of migration models are considered in the study.

In the first case, average income in R (Y_R) is treated as an exogenous variable. Equations (3.4), (3.5), and (3.6) can be combined with the migration equation,

$$M = \phi_0 + \phi_1 NR + GOVT\, \phi_2 + AGE\, \phi_3 + Z_{2R}\, \phi_4 + \varepsilon_M \tag{3.7}$$

where GOVT is a government policy vector, AGE is age structure for a county measured by the percentage of nonworking ages in the population (those less than 15 years old and of population 65 years old and over), and Z_{2R} is a subset of Z_R. Z_R is decomposed to two parts, one affects only average income (Z_{1R}) and the other one affects both average income and migration (Z_{2R}).

At any point in time, since residents in rural counties face the same urban location-specific characteristics, $\beta_{OU} + Z_U\xi_U$ is a fixed effect across counties. We can rewrite equation (3.6) as

$$EY_{U,R} = \alpha_U + H_R\beta_U \tag{3.8}$$

where $\alpha_U = \beta_{OU} + Z_U\xi_U$. Thus, we can get a migration equation of the form,

$$M = \phi_0 + \phi_1(\alpha_U + H_R\beta_U - Y_R) + GOVT\ \phi_2 + AGE\ \phi_3 + Z_{2R}\ \phi_4 + \varepsilon_M$$
$$= \delta_0 + H_R\ \delta_1 + \delta_2 Y_R + GOVT\ \delta_3 + AGE\ \delta_4 + Z_{2R}\ \delta_5 + \varepsilon_M \quad (3.9)$$

Where
$\delta_0 = \phi_0 + \phi_1\alpha_U$
$\delta_1 = \phi_1\beta_U$
$\delta_2 = -\ \phi_1$
$\delta_i = \phi_{i-1}, \qquad i = 3, 4, 5.$

It is also interesting to know how income components affect migration. To examine that issue, the corollary to (3.5) for income in R is

$$Y_R = \beta_{OR} + H_R\beta_R + Z_R\xi_R + \varepsilon_R \quad (3.10)$$

Substituting (3.8) for Y_R in (3.7), we can get another migration equation of the form:

$$M = \delta_0 + H_R\ \delta_1 + \delta_2(\beta_{OR} + H_R\beta_R + Z_R\xi_R + \varepsilon_R) + GOVT\ \delta_3 + AGE\ \delta_4 + Z_{2R}\ \delta_5 + \varepsilon_M$$
$$= \theta_0 + H_R\ \theta_1 + Z_{1R}\theta_2 + \theta_3\varepsilon_R + GOVT\ \theta_4 + AGE\ \theta_5 + Z_{2R}\ \theta_6 + \varepsilon_M \quad (3.11)$$

where
$\theta_0 = \delta_0 + \delta_2\beta_{OR}$
$\theta_1 = \delta_1 + \delta_2\beta_R = \phi_1(\beta_U - \beta_R)$
$\theta_2 = \delta_2\xi_{1R} = -\ \phi_1\xi_{1R}$
$\theta_3 = \delta_2 = -\ \phi_1$
$\theta_i = \delta_{i-1}, \quad i = 4, 5$
$\theta_6 = \delta_2\xi_{2R} + \delta_5 = -\ \phi_1\xi_{2R} + \phi_4$
$\varepsilon_R = Y_R - Y_{Rhat}.$

Income is considered as an endogenous variable in the second case. If Y_R is endogenous because average income changes when low income or high income people migrate out or in, or if Y_R is measured with error, then instruments for rural income will need to be added to the system. Using the regressors in equation (3.10) as instruments to predict rural income (EY_R), a modified migration equation can be derived as

$$M = \varphi_0 + H_R\,\varphi_1 + \varphi_2 EY_R + GOVT\,\varphi_3 + AGE\,\varphi_4 + Z_{2R}\,\varphi_5 + \varepsilon_M \qquad (3.12)$$

Substituting equation (3.10) for EY_R, a second modified migration equation can be derived of the form,

$$\begin{aligned} M &= \delta_0 + H_R\,\delta_1 + \delta_2(\beta_{OR} + H_R\beta_R + Z_R\xi_R) + GOVT\,\delta_3 \\ &\quad + AGE\,\delta_4 + Z_{2R}\,\delta_5 + \varepsilon_M \\ &= \pi_0 + H_R\,\pi_1 + Z_{1R}\pi_2 + GOVT\,\pi_3 + AGE\,\pi_4 \\ &\quad + Z_{2R}\,\pi_5 + \varepsilon_M \end{aligned} \qquad (3.13)$$

where $\pi_0 = \delta_0 + \delta_2\beta_{OR}$

$\pi_1 = \delta_1 + \delta_2\beta_R = \phi_1(\beta_U - \beta_R)$

$\pi_2 = \delta_2\xi_{1R} = -\phi_1\xi_{1R}$

$\pi_i = \delta_i, \qquad i = 3,\ 4$

$\pi_5 = \delta_2\xi_{2R} + \delta_5 = -\phi_1\xi_{2R} + \phi_4.$

Local governments may adjust their policies as populations change. Local government policy variables may also be measured with error due to time lag of the data. Thus, predicted local government policy is used[4]. Suppose that local government policy is affected by the determinants of migration (population change), X_1, and by non-migration-related factors, X_2. A regression of local government policy can be written as

$$G_{t+n} = \sigma_0 + X_{1t}\,\sigma_1 + D\,X_{1t}\,\sigma_2 + X_{2t}\,\sigma_3 + D\,X_{2t}\,\sigma_4 + \varepsilon_{t+n},$$

$n = 2,\ 7,$

$t = 1950,\ 1960,\ 1970,\ 1980,$ and

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[4] Estimates of migration equations were also attempted using observed local government policy variables. The two-stage estimates performed better and were preferred on theoretical grounds.

$$D = \begin{cases} 1 & \text{if } n = 7 \\ 0 & \text{if } n = 2 \end{cases} \quad (3.14)$$

where, G_{t+n} is local government policy at year t+n, which includes per capita tax revenue, per capita debt outstanding, per capita public welfare expenditure, per capita education expenditure, and highway expenditure. X_{1t} is the determinants of county population change, Mc(t, t-10), described in equation (3.9) or (3.12), X_{2t} is local government policy instruments other than X_{1t}, σ's are parameters, and ε_{t+n} is an error term at year t+n. From equation (3.14), predicted local government policy at year t+n, based on information at year t, can be derived as

$$EG_{t+2} = \Sigma_0 + X_{1t}\,\Sigma_1 + X_{2t}\,\Sigma_3 \quad (3.15.1)$$

or

$$EG_{t+7} = \Sigma_0 + X_{1t}\,(\Sigma_1 + \Sigma_2) + X_{2t}\,(\Sigma_3 + \Sigma_4) \quad (3.15.2)$$

where Σ's are estimated values of the σ's. The predicted value of local government policy for the decade, based on information available at year t is assumed to be the average of EG_{t+2} and EG_{t+7}.

Data Description

County populations were divided into farm and nonfarm subpopulations. However, these data sources are very limited. The long period studied poses another problem of obtaining consistent data for all years. Macro data are used in the study and most of them are Census data. The procedures used to compute the variables are reported in Appendix A.

Sample Selection

The 1960 Census of Population reports county farm population by age only for those counties with farm populations above 400. To study migration patterns of farm populations, it was necessary to include counties with farm populations of at least 400 in 1960. This means that the study only includes counties with a relatively important agricultural base. In order to standardize county geographical size and agricultural orientation, counties in the Midwest and the South are used.

A report "Rural-Urban Continuum Codes for Metro and Nonmetro Counties" by Margaret A. Butler (1990) provides a one-digit code for each of 10 municipal density classifications for all US counties in 1980. According to definitions in that report, counties with urban population less than 20,000 in 1980 were given Beale codes 6 to 9, which designated them as "rural" or "nonmetro" counties. There is no comparable designation of rural counties in 1950. For that reason, following Butler's definition above, all counties of 17 states in the Midwest and the South with urban populations less than 20,000 in 1950 and with farm populations greater than 400 in 1960 were designated as rural counties.

According to the 1960 Census of Population and the 1952 County and City Data Book, there were 1266 counties in the 17 states which met this criterion: Alabama (53)[5], Arkansas (68), Illinois (73), Indiana (73), Iowa (84), Kansas (95), Kentucky (112), Louisiana (51), Minnesota (76), Mississippi (74), Missouri (103), Nebraska (87), North Dakota (50), Oklahoma (63), South Dakota (64), Tennessee (88), and Wisconsin (52). From the population,18 counties per state were randomly selected. That is, 306 counties per decade are in the stratified random sample.

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[5] The numbers of rural counties in 1950 which have farm population more than 400 in 1960 are in parentheses after each states.

CHAPTER 4. RESULTS

Rural population growth[6] was not unique either across counties or over decades. According to Table 1.2, even though farm population has declined substantially since 1950, farm population was still increasing in some counties. The working age farm populations even grew three to seven times in some counties (maximum) during the decade of 1980-1990. County population growth depends not only on the growth of farm population but also on the growth of nonfarm population. A rural county may grow with a decrease in farm population. What affects the rural population changes from 1950 to1990? Do those factors affect farm and nonfarm populations differently? Can local government affect the population changes? The questions raised in chapter one will be discussed in this chapter.

Because of our interest in the role of rural income on migration and the potential difficulties associated with measurement error in farm and nonfarm income, estimation of income equations[7] will be discussed first. The first section discusses the results of rural average income equations. The equations of county population growth are presented in the second section, while those of farm and nonfarm population growth are presented in the third section. Conclusions of the chapter are address in the last section. The effects of income components on population growth and the regressions of predicted local government policy will be discussed in the Appendix B and Appendix C, respectively.

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[6] Population growth from year t-10 to year t is defined as $(N_t-N_{t-10})/N_{t-10} \approx \ln(N_t/N_{t-10})$. Thus, $\ln(N_t/N_{t-10})$ is used in regressions.

[7] All variables used in modles of this study are in log form.

Rural Average Income

As discussed in chapter 3, average income in a county is assumed to be determined by past human capital investments, local labor market conditions, and other location-specific characteristics. Based on these assumptions, three average income regressions are fitted. The first income regression is based on the average income of county residents and the second and the third regressions are based on average income of farm and nonfarm residents in that county (farm income and nonfarm income). The findings of these average income regressions are analyzed in this section.

The random sample includes 1224 observations generated from 306 counties over four decades. Specification (3.5) in log form is used for regressing rural average income. Three period dummy variables are used in the income equations to correct for definition changes in Census of Population, Census of Agriculture, and Census of Housing[8] and to capture other time-specific factors. Results of the regressions are summarized in Table 4.1.

County income

Eight-six percent of the variance in rural county income can be explained by the regression. All coefficients in the regression are significantly different from zero at the 0.5 percent level.

As expected, average income in a rural county is positively related to its human capital investment. A ten percent increase in human capital (as proxied by a ten percent

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[8] The detail of definition changes in Census of Population, Census of Agriculture, and Census of Housing will be reported in Appendix A.

Table 4.1. Rural income regressions, county data

Explanatory Variables	County Income (per capita)	Farm Income (per capita)	Nonfarm Income (per capita)
Intercept	7.728	5.832	8.707
	(9.296)[a]	(4.592)	(10.201)
Medn school years completed	0.176	0.469	0.141
	(2.279)	(3.993)	(1.784)
Ptge of pop with high school degree	0.170	0.039	0.160
	(4.656)	(0.692)	(4.255)
Herfindahl index of employment	-0.136	-0.035	-0.129
	(-6.949)	(-1.164)	(-6.389)
Ptge of farm population	-0.067	-0.130	-0.020
	(-7.859)	(-9.955)	(-2.231)
Avg size of farm	0.044	0.146	-0.005
	(3.480)	(7.541)	(-0.354)
Value of land & bdings per acre	0.095	0.166	0.057
	(7.782)	(8.981)	(4.615)
Value of crop prdt sold / Value of total prdt sold	0.018	-0.017	0.026
	(2.902)	(-1.874)	(4.153)
Distance to a city with pop > 100,000	-0.030	-0.026	-0.041
	(-3.015)	(-1.702)	(-4.001)
Medn gross monthly rent	0.413	0.364	0.447
	(13.695)	(7.816)	(14.287)
Avg Jan temp (1931-1960)	0.086	0.104	0.069
	(4.089)	(3.253)	(3.216)

[a] t-values are in the parentheses.

Table 4.1. (Continued)

Explanatory Variables	County Income (per capita)	Farm Income (per capita)	Nonfarm Income (per capita)
Avg July temp (1931-1960)	-0.770 (-4.060)	-0.677 (-2.337)	-0.795 (-4.084)
Avg annual rainfall (1931-1960)	-0.156 (-4.141)	-0.009 (-0.153)	-0.200 (-5.212)
Ptge of blacks in total pop	-0.010 (-3.074)	-0.026 (-5.240)	0.003 (0.842)
1950 dummy	0.922 (30.150)	0.998 (21.517)	0.789 (25.293)
1960 dummy	-0.155 (-5.997)	-0.194 (-4.930)	-0.218 (-8.252)
1970 dummy	0.083 (3.968)	0.095 (3.022)	0.019 (0.897)
F-VALUE	476.028	269.883	395.622
R^2	0.863	0.785	0.842

increase in both median school years completed and percentage of population with a high school degree)[9] raise average income by 3.5 percent.

The findings of the regression show that average county income is inversely related to the Herfindahl index of employment. Recall that the more dispersed the industrial mix, the smaller the Herfindahl index of employment. In other words, county income rises with increased diversity in industry mix.

The average size of farm and the average value of the land and buildings per acre are positively related to rural income as expected. A ten percent increase in farm size is associated with an increase in rural income of 0.4 percent, while a ten percent increase in the average value of the land and buildings is accompanied by an increase in rural income of one percent. The results show that rural income rises with the scale of agricultural production per farm.

The degree of concentration on crop products in a county is expected to affect average income in the county. The results obtained here show that higher concentration on crop product has a significant but small positive effect on county average income.

The closer a rural county is to a large city[10], as anticipated, the higher is county income. Therefore, the importance of the interaction between a rural county and its nearest big city cannot be ignored.

Median gross monthly rent is one of the factors used in this study to adjust for variation in the cost of living across counties. When county residents bear higher rent, higher income is required to compensate for the increased cost of living. According to

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[9] A ten percent increase in human capital will be referred as a proxy of a ten increase in both median school years completed and percentage of population with a high school degree.

[10] Distance to the nearest city with a population of (1) at least 25,000 in 1950 and (2) at least 100,000 in 1950 were both considered in preliminary regressions. However, only the second measure is used in the final regressions.

the regression, a ten percent increase in rent is accompanied by a 4.1 percent increase in rural average income.

Average January and July temperature and average annual rainfall from 1931 to 1960 are used as local weather measures. The weather measures help to adjust for local cost of living and may also affect the productivity of weather dependent products. When a county has nice weather in general, residents in that county do not have high weather related expenditures, say, on electricity used for heating or air-conditioning. The cost of living, then, should be low. On the other hand, nice weather will tend to raise property values, raising living costs. Weather may also affect the types of crops grown or crop productivity. In the regression, the total effect of average January temperature is positive, but small. However, the total effects of average July temperature and average annual rainfall are negative. When average July temperature (average annual rainfall) increases ten percent, per capita county income falls by 7.7 percent (1.5 percent).

Higher proportional black population in 1950 is associated with lower county income. However, the effect is very small. A ten percent increase in black percentage in the population reduces county income by one-tenth of one percent.

Farm and nonfarm income

Because of missing data on farm and nonfarm income in some counties, there are only 1203 observations used in farm and nonfarm income regressions. In addition, county-wide measures of human capital investment are used instead of measured education specific to the farm and nonfarm subgroups due to lack of data. Seventy-eight percent and eighty-four percent of the variance in farm and nonfarm income are captured by farm and nonfarm income regressions, respectively. Most of the coefficients in the two regressions are significant at the 0.5 percent level.

Except for the negative but insignificant effect of average size of farm on nonfarm income, and the negative effect of the ratio of the value of crop products sold to the value of total products sold on farm income, the signs of explanatory variables in both income regressions are the same as those in the county income regression. To prevent repeating, this section will only concentrate on the comparison of the effects of explanatory variables on farm and nonfarm income.

Human capital investment has a larger effect on farm income than on nonfarm income. A ten percent increase in human capital results in a 5.1 percent increase in farm income, but only a 3.0 percent in nonfarm income.

The regression results show that industry concentration has a significant negative effect on nonfarm income. However, industry concentration has only an insignificant and small negative effect on farm income.

Distance from the center of a rural county to its nearest big city has a significant negative effect on nonfarm income. The effect on farm income is smaller and only marginally significant. Nonfarm residents presumably take more advantage of commuting opportunities than farm residents. Overall, farm income is less sensitive to nonfarm labor market conditions than is nonfarm income.

When the average size of a farm in a county increases by ten percent, farm average income increases by 1.5 percent in that county. However the average size of a farm has no significant effect on nonfarm income. The value of land and buildings per acre has positive and a significant effect on both farm and nonfarm income. Nevertheless, this effect is about 3 times greater on farm income than on nonfarm income. Thus, agriculture productivity affects county farm income more than nonfarm income.

The degree of agricultural product concentrated in crops has a small positive but significant effect on nonfarm income. However, it has negative but only marginally significant effect on farm income. This may imply that the effect of agricultural product mix on average income is not as important as expected.

Except for the effect of average annual rainfall on farm income, weather has a significant effect on farm and nonfarm income. According to the regressions, farm income is more sensitive to average January temperature, but nonfarm income is more sensitive to average July temperature. Average annual rainfall has a negative effect on both farm and nonfarm income.

Counties with higher proportion of blacks in the population have lower farm incomes. There is no relationship between percentage black and nonfarm income.

County Population Growth

The results of migration equation (3.9) and (3.12) are analyzed in this section using different measures of county income. Three period dummy variables are used in the regressions to correct for the definition changes in Census of Population, Census of Agriculture, and Census of Housing[11] and to capture time-specific factors. Government policy may have different effects on population changes in Shannon county of South Dakota because it does not have a county government. A county dummy variable is used to capture the effect.

There are 17 states with 18 counties per state in my sample. Thus, 1224 observations (generated from 306 counties over four decades) are used in the regressions. The results of the county migration equation (the equations of county population growth) are in Table 4.2. The first equation contains observed rural income as a regressor, while the second equation uses predicted rural income generated from equation (3.10) as a regressor. Hausman tests were used to test the exogeneity

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[11] The detail of definition changes in Census of Population, Census of Agriculture, and Census of Housing will be reported in the Appendix A.

Table 4.2. Regressions of county population growth rate with observed or predicted rural average income as a regressor

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	using Obs. income (Y_R)	using Pre. income (EY_R)	using Obs. income (Y_R)	using Pre. income (EY_R)
Intercept	0.18 (0.08)[a]	2.82 (1.65)	-1.01 (-0.34)	2.86 (1.33)
Medn school years completed	-0.15 (-1.88)	-0.09 (-1.04)	-0.35 (-3.06)	-0.25 (-2.23)
Ptge of pop with high school degree	-0.00 (-0.05)	0.05 (1.17)	0.02 (0.42)	0.09 (1.59)
Rural average income	0.12 (1.35)	-0.05 (-0.70)	0.18 (1.16)	-0.07 (-0.09)
Distance to a city with pop > 100,000	-0.03 (-2.52)	-0.04 (-3.79)	-0.04 (-2.36)	-0.05 (-3.74)
Herfindahl index of employment	-0.11 (-3.33)	-0.10 (-3.69)	-0.17 (-3.72)	-0.15 (-3.90)
Ptge of pop less than 15 years old	-0.07 (-0.76)	-0.14 (-1.85)	-0.20 (-1.73)	-0.29 (-3.06)
Ptge of pop 65 years and over	-0.03 (-0.91)	-0.04 (-1.12)	-0.03 (-0.64)	-0.04 (-0.90)
Predicted local govt tax revenue (per capita)	-0.11 (-4.03)	-0.13 (-3.71)	-0.11 (-2.89)	-0.12 (-2.53)
Predicted local govt edu expenditure (per capita)	-0.02 (-0.37)	-0.01 (-0.16)	0.02 (0.23)	0.03 (0.37)
Predicted local govt LR debt outstanding (per capita)	0.03 (0.54)	0.09 (2.69)	-0.02 (-0.21)	0.07 (1.74)
Predicted local govt public welfare expenditure (per capita)	0.02 (1.69)	0.01 (1.26)	0.03 (1.84)	0.02 (1.39)

[a] t-values are in the parentheses and have been corrected for heteroskedasticity.

Table 4.2. (Continued)

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	using Obs. income (Y_R)	using Pre. income (EY_R)	using Obs. income (Y_R)	using Pre. income (EY_R)
Predicted local govt highway expenditure	0.05 (2.74)	0.04 (2.47)	0.05 (2.35)	0.04 (1.92)
State govt highway expenditure (State level)	-0.06 (-4.25)	-0.06 (-4.21)	-0.09 (-4.40)	-0.25 (-2.23)
ptge of farm pop	-0.02 (-2.28)	-0.03 (-2.69)	-0.02 (-1.84)	-0.03 (-2.37)
Ptge of blacks in total pop	-0.01 (-4.26)	-0.02 (-4.63)	-0.01 (-2.77)	-0.02 (-3.11)
Avg Jan temperature (1931-1960)	0.08 (1.76)	0.22 (3.71)	0.06 (1.03)	0.20 (2.77)
Avg July temperature (1931-1960)	-0.03 (-0.67)	-0.50 (-1.48)	0.17 (0.28)	-0.52 (-1.16)
Avg annual rainfall (1931-1960)	-0.01 (-0.15)	-0.09 (-1.51)	0.10 (0.98)	-0.01 (-0.16)
Shannon county dummy	0.27 (3.37)	0.24 (3.12)	0.41 (4.49)	0.38 (4.18)
1950s dummy	-0.23 (-3.68)	-0.12 (-2.81)	-0.26 (-3.04)	-0.15 (-2.44)
1960s dummy	0.07 (2.19)	0.07 (2.19)	0.25 (5.31)	0.24 (5.13)
1970s dummy	0.15 (9.27)	0.15 (8.26)	0.27 (13.31)	0.27 (11.36)
F value	37.82	37.01	51.46	50.95
R^2	0.41	0.40	0.49	0.48

assumption for rural income. The Hausman tests could not reject the exogeneity assumption (t-values are -0.48 and -0.90 in full and young working age groups, respectively). Therefore, the results of the regressions of county population growth using observed per capita county income as a regressor will be discussed.

In general, the results are similar across both age groups, but the dependent variable in the young working age group is a bit more sensitive to changes in the explanatory variables. That is, the regressors have more power for explaining variation in county population change for the young working age group (49 percent) than the working age group as a whole (41 percent).

Human capital investment measures have a negative joint effect on the population growth. The effect is significant at the five percent level on the growth of young working age populations. When human capital investments increase ten percent, holding other factors constant, population growth decreases 3.3 percent for the young working age group, and 1.5 percent for the full working age group. The results are consistent with Hypothesis 1 and the findings in most previous studies. The effect of human capital investments on population growth for the young working age group is more than twice as large as it is for the full working age group. It suggests that the net return of human capital investment through out-migration from rural areas is higher for younger workers than for the overall working age population, presumably because of the longer return stream from migration for younger workers. The negative effects of past human capital investments on population growth discussed above indicate that brain drain happened in rural counties.

The presence of dependents in a family is expected to reduce the mobility of the family. Age structure variables (the percentage of population less than 15 years old and the percentage of population of ages 65 and over) are used to capture the effects of the young and old dependents in families. These variables also help to correct for the use of population changes rather than net migration as the dependent variable. Older populations will have more deaths, while younger populations should have more births than average. However, Wald tests showed that age structure variables have an insignificant impact on population changes (Wald statistic is 0.8856 for the full working age populations and is 3.3943 for the young working age populations. χ^2 (2, 0.050) = 5.99). Higher proportion of dependents in county population is associated with decreased population growth.

Observed rural income has a positive but insignificant effect on the population growth. A ten percent increase in rural income is associated with increased population growth of 1.2 to 1.8 percent. From equation (3.9), we know $\delta 2 = -\phi 1$. That is, net returns to migration, NR, are expected to have the same effect on the population growth rate as rural income has, but in a different direction. Thus, rural counties with relatively low average income or high expected net return from migration will lose population, holding human capital fixed. The associated positive effect of average income or the negative effect of expected net return from moving on population growth is consistent with Hypothesis 2.

Rural county development is positively and significantly related to proximity to a large city[12]. The effect holding income fixed is small. Less than a one-half percent increase in population growth is associated with a ten percent decrease in the distance

[12] In order to prevent the endogeneity of the distance variable, the 1950 big cities are used in the models to measure the distance from a rural county to its nearest big city. Preliminary regressions also considered distance to (1) cities of population at least 25,000 in 1950 and (2) cities of population at least 100,000 in each decade have been considered in the study. Similar results are obtained using those measures.

measure, holding income fixed. The distance measure also affects income, but the income effect is not big, either[13].

The Herfindahl index turns out to be negatively and significantly related to rural population growth as hypothesized. That is, if other factors remain the same, a rural county with relatively high industrial diversity has higher population growth rate than other rural counties[14].

Consistent with Hypothesis 3, local government intervention as a whole appears to have little impact on population growth. However, tax and expenditure policies individually do have an impact on population growth. A Wald test rejects the null hypothesis at the one percent level that all local government policies have no effect on the population growth rate (Wald statistic is 38.0964 for the full working age populations and is 22.0720 for the young working age populations. χ^2 (5, 0.010) = 15.09).

In theory, per capita local government tax represents the current financial obligation of residents, so more tax obligation in a county should reduce its population growth. The results obtained here show that a ten percent increase in local tax revenue is associated with a 1.1 percent decrease in county population growth. On the other hand, per capita long-term debt outstanding presents a future financial obligation for current residents. Results show that it has a small negative effect on young working age population growth, but a small positive effect on full working age population growth. Nevertheless, the joint effect of per capita local government tax revenue and long-term

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13 $\partial POP/\partial DIST = (\partial Y/\partial DIST)(\partial POP/\partial Y) + \partial POP/\partial DIST = (-0.030)(0.12) + (-0.03)$, where POP, DIST, and Y are population change, the distance measure, and average income, respectively.

14 $\partial POP/\partial HIDX = (\partial Y/\partial HIDX)(\partial POP/\partial Y) + \partial POP/\partial HIDX = (-0.136)(0.12) + (-0.11)$, where POP, HIDX, and Y are population change, Herfindahl index of employment, and average income, respectively.

debt outstanding on population growth rate is negative and significant. A ten percent increase in both the taxes and the long-term debt issued are associated with a drop in population growth by 0.8 to 1.3 percent.

Education expenditure is one of the most important government expenditures and local governments share most of the expenditure. Although per capita local government education expenditure has a positive effect on young working age population growth and a negative effect on full working age population growth, the effects are small and insignificant.

Unlike education expenditure, government highway expenditure has a significant effect on rural county population changes. When a state government spends more on highways, rural county population growth decreases. A ten percent increase in state government highway expenditure causes a 0.6 to 0.9 percent decline in rural population growth. However, local government highway expenditure has the opposite effect on rural county population growth. The results suggest that rural population increases with the quality of local highway services, but decrease with the quality of state highway services, assuming that highway services increase with highway expenditures. The overall effect of state and local highway expenditure is small and negative. It is possible that local highway services shorten the time to commute from a rural county to its nearest big city. However, the total effect of improved highway services appears to reduce the cost of moving away from rural counties.

Per capita local government public welfare expenditure has a positive and significant effect on rural population changes. However, the effect is small. A ten percent increase in per capita local government public welfare expenditure increases rural population growth by 0.2 to 0.3 percent.

The elasticities of rural population growth with respcet to local government expenditure, the sum of local government expenditure and local tax revenue, and the sum of local government expenditure, local tax revenue and local debt outstanding, respectively, are 0.050, 0.000, and -0.030 for the full working age group, and 0.100, 0.089, and 0.069 for the young working age group[15]. However, Wald tests cannot reject the null hypotheses at the five percent level that rural county population growth is neutral toward aggregate local government expenditure, toward the sum of local government expenditure and local tax revenue, and toward the sum of local government expenditure, local tax revenue and local debt outstanding. Local government public services have a very small insignificant positive impact on rural population growth. However, if the services are financed by taxes or by taxes and debt, then the impact of local governments on population growth is even smaller.

Farm and Nonfarm Population Growth

While farm populations fell substantially in rural counties, nonfarm population did not change uniformly either across counties or over time. County population is divided into farm and nonfarm residents to capture the different migration propensity between these two subgroups. Following the analysis in the county population growth section, equation (3.9) and (3.12) are used to analyze farm and nonfarm population growth. The results of regressions with observed average income of farm and nonfarm population as regressors are shown in Table 4.3, while the results of regressions with predicted average income of farm and nonfarm population as regressors are presented in Table 4.4. Hausman tests were used to test the validity of using observed measures of average farm and nonfarm income. In this case, the Hausman test of the predicted farm and nonfarm income strongly rejected the hypothesized exogeneity of farm and nonfarm income (F values of the tests for farm and nonfarm population growth, respectively,

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[15] A summary of the elasticities and Wald tests for county populations as a whole will be reported in Table 4.5 with the summary of those for farm and nonfarm populations.

Table 4.3. Regressions of farm and nonfarm population growth rate with observed average income as a regressor

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Intercept	-8.39 (-2.86)[a]	-7.23 (-0.13)	-4.82 (-1.24)	-8.04 (-2.63)
Medn school years completed	-0.43 (-2.38)	-0.20 (-1.44)	-0.65 (-2.82)	-0.38 (-2.46)
Ptge of pop with high school degree	0.27 (3.41)	-0.20 (-3.69)	0.33 (3.24)	-0.14 (-2.08)
Observed avg farm income in R	0.36 (5.92)	-0.02 (-0.53)	0.33 (4.35)	0.02 (0.65)
Observed avg nonfarm income in R	0.10 (1.19)	0.32 (4.25)	0.04 (0.32)	0.32 (3.62)
Distance to a city with pop > 100,000	-0.03 (-1.46)	-0.02 (-1.18)	-0.03 (-1.08)	-0.03 (-1.82)
Herfindahl index of employment	0.01 (0.30)	-0.13 (-3.64)	0.06 (0.94)	-0.13 (-2.97)
Ptge of pop less than 15 years old	-0.22 (-2.62)	0.14 (2.13)	-0.55 (-4.57)	0.01 (0.10)
Ptge of pop 65 years and over	-0.17 (-4.21)	-0.01 (-0.37)	-0.21 (-3.13)	-0.00 (-0.09)
Predicted local govt tax revenue (per capita)	-0.05 (-0.98)	-0.14 (-4.13)	0.00 (0.04)	-0.14 (-3.18)
Predicted local govt edu expenditure (per capita)	-0.03 (-0.32)	-0.07 (-1.17)	0.06 (0.53)	-0.02 (-0.29)
Predicted local govt LR debt outstanding (per capita)	-0.11 (-1.41)	-0.17 (-2.75)	-0.00 (-0.01)	-0.18 (-2.54)
Predicted local govt public welfare expenditure (per capita)	0.06 (3.30)	0.06 (3.93)	0.07 (2.80)	0.07 (3.58)

[a] t-values are in the parentheses and have been corrected for heteroskedasticity.

Table 4.3. (Continued)

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Predicted local govt highway expenditure	-0.12 (-3.38)	0.12 (5.64)	-0.16 (-3.31)	0.11 (4.36)
State govt highway expenditure (State level)	-0.02 (-0.73)	-0.06 (-3.76)	-0.67 (-2.11)	-0.08 (-3.68)
Ptge of blacks in total pop	-0.01 (-2.93)	-0.02 (-5.82)	-0.02 (-2.60)	-0.02 (-4.00)
Avg Jan temperature (1931-1960)	-0.17 (-3.00)	-0.03 (-0.56)	-0.05 (-0.63)	-0.05 (-0.85)
Avg July temperature (1931-1960)	1.29 (2.12)	1.98 (3.73)	0.28 (0.34)	2.08 (3.26)
Avg annual rainfall (1931-1960)	0.36 (3.79)	0.08 (0.96)	0.46 (3.46)	0.17 (1.61)
Shannon county dummy	-0.36 (-1.66)	0.14 (0..94)	0.10 (0.28)	0.29 (1.59)
1950s dummy	-0.14 (-1.39)	-0.35 (-5.15)	-0.22 (-1.72)	-0.33 (-3.92)
1960s dummy	0.30 (5.49)	-0.08 (-2.04)	0.39 (5.53)	0.14 (2.81)
1970s dummy	0.37 (11.51)	0.08 (3.96)	0.50 (11.77)	0.19 (8.67)
F value	34.65	21.89	40.71	25.29
R^2	0.39	0.29	0..43	0.32

Table 4.4. Regressions of farm and nonfarm population growth rate with predicted average income as a regressor

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Intercept	-11.69 (-3.85)[a]	1.89 (0.95)	-10.86 (-2.59)	2.13 (0.85)
Medn school years completed	-0.50 (-2.77)	0.22 (1.88)	-0.84 (-3.62)	-0.04 (-0.75)
Ptge of pop with high school degree	-0.02 (-0.28)	-0.05 (-1.00)	-0.03 (-0.33)	0.04 (0.28)
Predicted avg farm income in R	0.74 (5.77)	-0.42 (-5.81)	0.87 (5.07)	-0.29 (-3.35)
Predicted avg nonfarm income in R	0.02 (0.11)	0.18 (1.58)	-0.04 (-0.16)	0.07 (0.51)
Distance to a city with pop > 100,000	0.01 (0.24)	-0.04 (-3.67)	0.02 (0.76)	-0.07 (-4.21)
Herfindahl index of employment	0.09 (2.30)	-0.03 (-0.78)	0.10 (1.92)	-0.04 (-0.75)
Ptge of pop less than 15 years old	-0.33 (-4.33)	0.09 (1.30)	-0.63 (-5.93)	-0.03 (-0.32)
Ptge of pop 65 years and over	-0.12 (-3.30)	-0.03 (-0.86)	-0.16 (-2.54)	-0.01 (-0.16)
Predicted local govt tax revenue (per capita)	0.02 (0.40)	-0.12 (-2.93)	0.08 (1.05)	-0.11 (-2.07)
Predicted local govt edu expenditure (per capita)	-0.07 (-0.83)	-0.11 (-1.98)	0.01 (0.05)	-0.09 (-1.08)
Predicted local govt LR debt outstanding (per capita)	-0.10 (-1.76)	0.07 (1.61)	-0.07 (-0.97)	0.06 (1.22)
Predicted local govt public welfare expenditure (per capita)	0.04 (2.40)	0.03 (1.91)	0.06 (2.54)	0.03 (1.62)

[a] t-values are in the parentheses and have been corrected for heteroskedasticity.

Table 4.4. (Continued)

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Predicted local govt highway expenditure	-0.13 (-3.94)	0.06 (3.58)	-0.14 (-3.08)	0.06 (2.43)
State govt highway expenditure (State level)	0.02 (0.89)	-0.04 (-2.93)	-0.04 (-1.42)	-0.06 (-2.84)
Ptge of blacks in total pop	-0.00 (-0.25)	-0.03 (-8.12)	-0.00 (-0.26)	-0.03 (-4.92)
Avg Jan temperature (1931-1960)	-0.33 (-3.40)	0.22 (2.63)	-0.24 (-1.84)	0.18 (1.94)
Avg July temperature (1931-1960)	1.46 (2.50)	0.23 (0.58)	0.97 (1.20)	0.14 (0.27)
Avg annual rainfall (1931-1960)	0.34 (3.78)	-0.10 (-1.40)	0.51 (3.99)	-0.04 (-0.41)
Shannon county dummy	-0.24 (-0.74)	0.24 (2.30)	0.04 (0.12)	0.35 (2.64)
1950s dummy	0.34 (4.81)	-0.41 (-7.51)	0.30 (3.21)	-0.35 (-5.10)
1960s dummy	0.40 (8.01)	-0.18 (-4.75)	0.51 (7.83)	0.05 (1.14)
1970s dummy	0.49 (15.03)	-0.00 (-0.22)	0.65 (15.96)	0.13 (5.33)
F value	35.91	22.47	43.52	24.50
R^2	0.40	0.29	0.44	0.31

are 35.85 and 16.46 in full working age group, and are 29.96 and 5.19 in young working age group. Prob > F is 0.0001 for the first three F values and is 0.0057 for the last F value.) Therefore, the results in Table 4.4 are preferred and will be discussed in this section.

Estimates based on equation (3.12) for farm and nonfarm residents and for full and young working age groups are shown in Table 4.4. Although the education level may vary between the farm and nonfarm subcategories in general, county-wide median school years completed and percentage with high school degree were used due to lack of data.

The results show that 29 to 44 percent of the variation in farm and nonfarm population changes is explained by the model. In general, the model has more power to explain variation in growth for farm population than for nonfarm population. As before, more of the variation in farm and nonfarm population growth can be explained for the young working age group than for the full working age group.

The median school years completed and the percentage of population with high school degree in a county jointly have a significant and negative effect on farm population changes, but have an insignificant effect on nonfarm population changes in the county, holding income and other factors constant. Wald tests of these variables cannot reject the null hypotheses at the 5 percent level that human capital investment has no effect on nonfarm population growth[16]. Thus, the brain drain effect appears to be concentrated in farm populations.

Average farm and nonfarm incomes are both included as elements of expected net revenue from migration. The results show that predicted average farm income and nonfarm income jointly have a significant effect on farm and nonfarm population

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[16] Wald statistic for the full working age group and the young working age group, respectively, are 9.1797 and 14.7842 for farm population and 3.6436 and 0.0799 for nonfarm population. χ^2 (2, 0.050) = 5.99.

change[17]. High farm income strongly slows down farm population loss, while nonfarm income has little effect on farm populations. Farm income has a negative effect on nonfarm populations. Apparently, the presumption that farm income policies spillover to the nonfarm sector is incorrect. In fact, the negative effect of farm income on nonfarm population changes is larger than the positive own effect of nonfarm income. However, the negative effect of farm income on nonfarm population changes could be due to the measurement error of farm and nonfarm populations if the measurement error problems is serious.

As hypothesized, the distance from a rural county to its nearest big city has a significant and negative effect on nonfarm population growth. Holding income constant, a ten percent decrease in the distance from a county to its nearest city with at least 100,000 population is associated with an increase in nonfarm population growth by 0.4 to 0.7 percent. However, the off-farm labor market opportunities in a nearest big city are not as important to farm population growth as to nonfarm population growth. The effect of the distance measure on farm population growth is small and insignificant. Furthermore, income effects of the distance measure on farm and nonfarm population growth are very small. Through the changes in farm and nonfarm incomes, a ten percent decrease in the distance from a county to its nearest big city decreases less than a half of 0.1 percent on nonfarm population growth and increases less than a half of 0.1 percent of farm population growth.

As expected in Hypothesis 5, nonfarm population growth in a county is positively related to industrial diversity in the county. Counties with more diversified industrial mixes are associated with higher nonfarm population growth relative to counties with

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[17]Wald statistic for the full working age group and the young working age group, respectively, are 69.0219 and 43.6385 for farm population and 39.2465 and 16.4862 for nonfarm population. χ^2 (2, 0.010) = 9.21.

higher industrial concentration. However, the effects of industry diversity on farm population changes are opposite to those of nonfarm population changes. A county concentrated on only a few industries will have higher farm population growth than those with more diversified industrial mixes. A ten percent increase in Herfindahl index of employment will increase farm population growth by one percent.

Wald tests of local government policy variables reject the null hypothesis at the one percent level that all local government policies have no effect on explain farm and nonfarm population changes[18]. These findings are at variance with Hypothesis 3, although we will present evidence in favor of the hypothesis later.

Farm and nonfarm populations react differently to individual local government policies. Local government tax revenue has a negative effect on nonfarm population growth, but a positive effect on farm population changes. A ten percent increase in predicted per capita local government tax revenue will decrease nonfarm population growth by 1.1 to 1.2 percent, but increase farm population growth by 0.2 to 0.8 percent. In contrast, local government long term debt outstanding has a positive effect on nonfarm population growth, but a negative effect of farm population growth. A 0.6 to 0.7 percent increase in nonfarm population growth, but a 0.7 to 1.0 percent decrease in farm population growth will be associated with a ten percent increase in predicted per capita local government long term debt outstanding. The different reaction of farm and nonfarm population toward local tax and debt outstanding may result from different local tax and debt obligations posted in farm and nonfarm population.

Both local and state government highway expenditures have significant effects on farm and nonfarm population changes. A ten percent increase in predicted local

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[18]Wald statistic for the full working age group and the young working age group, respectively, are 44.9202 and 22.3046 for farm population and 46.6165 and 23.3630 for nonfarm population. χ^2 (5, 0.010) = 15.09.

government highway expenditure will increase nonfarm population by 0.6 percent but decrease farm population growth by 1.3 to 1.4 percent. However, an increase in state government highway expenditure is associated with a decrease in both farm and nonfarm population growth. The findings are consistent with the effect of the distance measure on farm and nonfarm population changes. That is, the off-farm labor market opportunities in a nearest big city are important to nonfarm populations but not to farm populations. When local government spend more on local highway to shorten the time to its nearest big city, nonfarm population increases due to the convenience of commuting to work. The improvement on overall highway in a state decreases moving cost of rural residents in the state, then increases out-migration and decreases rural population growth in the state. Nevertheless, local and state government highway expenditure jointly has a negative effect on farm population growth, but almost has no effect on nonfarm population growth.

Negative effects of local government education expenditure on farm and nonfarm population changes were found. About one percent decrease in farm and nonfarm population growth is associated with a ten percent increase in predicted per capita local government education expenditure. It further shows that brain drain happened in rural counties.

Local government public welfare expenditure has a significant effect on farm and nonfarm population growth as expected, but the effect is small. Only a half of one percent of farm and nonfarm population growth increases with a ten percent increase in predicted per capita local government public welfare expenditure.

The joint farm population growth elasticity of local government expenditure, of local government expenditure and tax revenue, and of local government expenditure, tax revenue, and debt outstanding, respectively, are -0.16, -0.14, and -0.24 in the full working age group, and are -0.07, 0.01, and -0.06 in the young working age group.

The joint nonfarm population growth elasticity of local government expenditure, of local government expenditure and tax revenue, and of local government expenditure, tax revenue, and debt outstanding, respectively, are -0.02, -0.14, and -0.07 in full working age group, and are 0.00, -0.11, and -0.05 in young working age group. Wald tests were used to test the neutrality of local government policy. The results of the tests are reported in Table 4.5. Wald tests reject at the one percent level the null hypothesis that farm population growth is neutral toward local government expenditure financed by local tax and debt together and reject at the five percent level the null hypothesis that nonfarm population growth is neutral toward local government expenditure financed by local tax alone in the full working age group. However, neutrality of local government policy on farm and nonfarm population growth cannot be rejected in the rest of the Wald tests. That is, in general, farm and nonfarm population growth is neutral toward local government policy. Farm and nonfarm population growth may be affected by individual local government policies, but they are neutral to self-financed increases in local government services.

Conclusions

Consistent with the findings in most previous studies, young working age population are more sensitive to migration factors than full working age population in this study. However, the results of regressions are consistent in both age groups. Human capital, local government policy, industrial diversity, the distance measure, and average income play important roles in the migration decision. All major parameters in regressions of population growth rates have the expected signs. Nevertheless, some of these factors affect farm and nonfarm populations differently. Individual local government policies have some impact on population changes, but rural population growth is neutral toward aggregate local government tax and expenditure policies. Although individual local government policies may affect farm and nonfarm population differently, in general, aggregate government tax and expenditure policies have neutral effects on both farm and nonfarm populations, particularly on the young.

Table 4.5. Neutrality tests of predicted local government policy

Test: Neutrality of	Full county populaiton		Farm population		Nonfarm population	
	Aged 20-64	Aged 20-34	Aged 20-64	Aged 20-34	Aged 20-64	Aged 20-34
A. Local govt expenditure	0.05[a]	0.10	-0.16	-0.07	-0.02	0.00
	0.6097[b]	1.4632	3.0216	0.3821	0.1106	0.0001
B. Local govt expenditure plus tax	0.00	0.09	-0.14	0.01	-0.14	-0.11
	1.3063	0.0073	2.1074	0.0020	4.6650	1.5080
C. Local govt expenditure plus tax plus debt outstanding	-0.03	0.07	-0.24	-0.06	-0.07	-0.05
	0.2969	0.0691	8.6047	0.4424	1.2761	0.3349

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

[b] Wald statistic. Critical values of χ^2 with degree of freedom of one are $\chi^2(1, 0.050) = 3.84$, $\chi^2(1, 0.025) = 5.02$, $\chi^2(1, 0.010) = 6.63$.

CHAPTER 5. SUMMARY AND CONCLUSIONS

This study analyzes the relative importance of factors believed to influence growth of working age populations in US rural counties. Human capital, income, local labor market characteristics, government policy, and other location-specific conditions are considered in regressions of ten-year population growth rates.

County average income may be affected by the moves of high income or low income populations or measured by error. Hausman tests are used to test the validity of using observed measures of county average income and of farm and nonfarm income. The tests cannot reject the exogeneity assumption of observed county average income, but reject the hypothesized exogeneity of farm and nonfarm income. Hence, the preferred regression results are those using observed county average income for county population changes and using predicted farm and nonfarm income for changes in farm and nonfarm populations.

Results showed that human capital, diversity of industrial mix, average income, and distance from a city are major determinants of rural population changes. As expected, a county with relatively low average income will have relatively low population growth. Evidence of brain drain from rural counties is found. More educated counties had relatively low population growth. Counties with more diversified industry had relatively high population growth. Rural counties closer to big cities also grow faster. The findings also showed that rural county population growth is neutral toward self-financed increased local government expenditure.

The major determinants of rural county population changes mentioned above affect farm and nonfarm populations differently. An increase in human capital investment in a county is associated with a decrease in farm population, but the negative effect of education does not appear in nonfarm population growth. Brain drain seems concentrated in farm population. Predicted farm income is significantly and positively related to farm population growth, but negatively related to nonfarm population growth. Predicted nonfarm income has a small positive but not significant effect on nonfarm population growth and its effect on farm population is even smaller. The distance measure has a negative and significant effect on nonfarm population growth, but a positive and insignificant effect on farm population growth. It seems that nonfarm population growth is more sensitive to urban labor markets. Diversity of industrial mix is positively related nonfarm population growth, but negatively related to farm population growth. Farm and nonfarm population changes are sensitive to the way local governments finance their public services. Farm populations prefer tax financed expenditure, but nonfarm populations prefer debt financing. Farm population decreases when local governments finance public services by both local tax and debt, but is neutral toward increased services financed by local taxes. Nonfarm population decreases when local governments use only local tax to finance public services, but is neutral toward increased public services financed by taxes and debt.

All variables used in the regressions of population growth rates are in log term. Thus, the parameters of the regressions represent the elasticity of population changes. A variable could have a very high elasticity, but if the variable does not change from 1950 to 1980, it will not explain any of the changes in population growth rates over time. In order to compare the magnitude of the population growth effects of major variables of interest, two sets of simulations are performed.

Simulated Time Series Effects

The effects of a variable on population growth over time can be illustrated through simulation. Define a baseline population change as the estimated population change from

1950 to 1960 which takes the estimated parameters of the model evaluated at the 1950 sample means of all continuous variables. The simulated population change due to changes in a single variable of interest is estimated by changing the variable to its 1980 level, holding all other variables at their 1950 levels. The difference between the latter simulated population change and the baseline population change is interpretable as the population change contributed by the variable of interest.

The simulated time series effects of rural population growth are shown in Table 5.1. For county population change in both age groups, human capital, industrial diversity, and predicted per capita local government tax revenue have big negative effects over time and the percentage of farm population has an important positive effect over time. The effects of observed income, percentage of blacks in total population, and predicted per capita local government public welfare expenditure are not important over time, on average. Local government expenditure has a small positive impact on the growth of young working age population over time, the effect disappears if it has to be financed either by local tax or by both local tax and debt. Therefore, on average, local government cannot stop losing rural population through tax and expenditure policies.

The simulated time series effects of farm and nonfarm population growth are shown in Table 5.2. On average, predicted farm income has the biggest positive effect on farm population changes over time and has the biggest negative effect on nonfarm population changes. However, predicted nonfarm income does not affect farm population growth much. Human capital in an average county has a big negative impact on farm population growth, but the impact on nonfarm population is very small. Local government public welfare expenditure and percentage of blacks in total population are not important explanatory factors for changes in farm or nonfarm populations. Predicted per capita local government tax revenue has a positive effect on farm population change, but has a negative effect on nonfarm population change. However, self-financed increased local government expenditure has a negative effect on both farm and nonfarm population changes over the period. Apparently, despite the neutral effects of equiproportional change in taxes and government services, actual local policies have tended to reduce both farm and nonfarm populations over time.

Simulated Cross-sectional Effects (Minimum and Maximum Effects)

A variable may also explain the cross-sectional variation in population growth, even if it does not change over time. This section simulates the cross-sectional effect of a variable of interest by setting the variable to its minmum and maximum values, holding all other variables at their 1950 levels. Comparison of the two simulated population changes illustrates the cross-sectional variation in population growth attributable to the variable.

The simulated cross-sectional effects of county population growth are presented in Table 5.3. Diversified industrial mix explains the largest variation in population growth across counties. Observed average income, human capital, local government policy, and the distance from a rural county to its nearest city also explain the gap in population growth between the fastest and slowest growing counties. The effects are larger in the young working age group than for the full working age group.

The simulated cross-sectional effects of farm and nonfarm population growth are presented in Table 5.4. Predicted farm income and human capital investment explain the largest proportion of the gap between fastest and slowest farm population growth counties. Farm populations grow fastest in counties with high farm income and low education levels. Farm populations grow fastest (or decline slowest) in counties with the most concentrated industrial mix. Public welfare also explain large differences in farm population growth rates with the least generous counties losing farm population at the faster rates. Variation in local government policy also contributes toward explanation of differences in farm population growth.

As the cross-sectional effect of farm income in farm population growth, predicted farm income explains the largest proportion of the gap between fastest and slowest nonfarm population growth counties. However, nonfarm populations grow fastest in counties with low farm incomes. Nonfarm populations grow fastest in counties with high education levels. However, human capital does not contribute toward explanation of the differences in nonfarm population growth as much as it does in farm population growth. Nonfarm income and public welfare also explain large differences in nonfarm population growth rates with the highest nonfarm income or the most generous counties increase nonfarm population at the faster rates. Variation in local government policy also contribute toward illustration of differences in nonfarm population growth.

Conclusions

General conclusions regarding to education, average income, distance to a big city, local government policy, and diversity of industrial mix are discussed in this section.

Education

Although high education is associated with high income, human capital investment in a county has a significant negative effect on rural county population change, especially on farm population change. The implication is that high education raise income for rural residents (especially farm population) more in urban areas than in the rural county of origin. Local governments cannot reduce rural population loss or farm population loss by increasing human capital investment. This is consistent with the insignificant effect of predicted local government education expenditure on rural population change and on farm population change.

Average income

High average income in the rural county raises population growth. The decline in farm population slows down with increases in farm income and the nonfarm population grows with increases in nonfarm income. Farm income also has a negative and significant effect on nonfarm population growth and it is larger than the own effect of nonfarm income. The cause of the big negative effect of farm income on nonfarm population change is not clear, but the implication is that increased farm income does not spillover to the nonfarm sector. The population decline in the nonfarm sector could be a result of inter-movement of farm and nonfarm population in a county. It could also be due to mismeasurement of farm and nonfarm income or of farm and nonfarm populations.

Distance to a big city

The distance from a rural county to its nearest city with population at least 100,000 in 1950 significantly and negatively affects overall population growth and nonfarm population growth in the county. It suggests that urban labor markets are important to rural population growth, especially for growth of the nonfarm population. If commuting cost from a rural county to its nearest big city is relatively low, it would attract population to stay and therefore the growth of overall population and of nonfarm population in the county will be relatively high. It is consistent with the positive and significant effect of predicted local government highway expenditure on overall population growth and on nonfarm population growth, assuming more highway expenditure guaranteeing higher road quality and shorter commuting time. However, the negative effect of state government highway expenditure suggests that improving the quality of local road is sufficient to remain some of the rural population. The investment on overall highways will induce rural populations to exit.

Local government policy

Although individual local government policies have some impact on rural population changes and they affect farm and nonfarm population growth differently, overall government policy has very little influence on population changes. Wald statistics suggest that the growth of total population, farm population, and nonfarm population in rural counties, are neutral toward local government expenditure, local government expenditure financed by tax alone, and local government expenditure financed by both tax and debt. The time series and cross-sectional simulations of population changes supported these findings. Those results suggest that local governments cannot prevent rural population decline by providing better services.

Diversity of industrial mix

Even though local governments cannot stop population moving out of a rural area by providing better public services, this study found that local governments can keep rural population and nonfarm population in a county by encouraging more diversified industries in the county. That is, local government policies which can attract more industries into a county would help development in the county.

Table 5.1. Simulated time series effects of rural county population growth attributable to individual variables[a] (Numbers in percentage)

Variables of interest (X_i)	Individuals aged 20-64		Individuals aged 20-34	
	ΔPOP_{Xi}	$\Delta POP_{Xi} - \Delta POP_b$	ΔPOP_{Xi}	$\Delta POP_{Xi} - \Delta POP_b$
Herfindahl index of employment	14.52	3.70	2.48	5.76
Percentage of farm pop	14.03	3.48	-0.19	3.09
Human capital investment	5.39	-5.43	-13.14	-9.87
Observed rural avg income	9.93	-0.89	-4.60	-1.32
Percentage of blacks in total pop	11.12	0.30	-3.00	0.28
Predicted local govt tax revenue (per capita)	2.73	-8.09	-11.42	-8.14
Predicted local govt public welfare expd (per capita)	9.72	-1.10	-5.06	-1.78
Predicted local govt expd	10.35	-0.47	-0.35	2.93
Predicted local govt policy I	1.41	-9.41	-8.06	-4.78
Predicted local govt policy II	2.26	-8.56	-8.49	-5.21

[a] ΔPOP_{Xi} is the estimated population change when the variable of interest Xi is changed to its 1980 level, holding all other variables at their 1950 sample means. ΔPOP_b is the estimated baseline population change, which holds all variables at the 1950 levels. ΔPOP_b equals 10.82 percent for the full working age group and -3.28 percent for the young working age group. Human capital investment includes median school years completed and percentage of population with at least high school degree. Predicted local government expenditure includes per capita public welfare expenditure, per capita education expenditure, and highway expenditure. Predicted local government policy I is the policy that predicted local government expenditure was financed by both local tax and debt. Predicted local government policy II is the policy that predicted local government expenditure was financed by only local tax.

Table 5.2. Simulated time series effects of farm and nonfarm population growth attributable to individual variables[a] (Numbers in percentage)

Variables of interest (X_i)	Individuals aged 20-64		Individuals aged 20-34	
	ΔPOP_{X_i}	$\Delta POP_{X_i} - \Delta POP_b$	ΔPOP_{X_i}	$\Delta POP_{X_i} - \Delta POP_b$
Farm Population Growth:				
Herfindahl index of employment	-90.07	-2.98	-117.57	-3.54
Human capital investment	-106.49	-19.4	-146.25	-32.13
Predicted farm income	-7.51	79.58	-21.13	92.99
Predicted nonfarm income	-85.93	1.16	-116.38	-2.26
Percentage of blacks in total pop	-87.06	0.03	-114.07	0.05
Predicted local govt tax revenue (per capita)	-84.98	2.11	-106.89	7.23
Predicted local govt public welfare expd (per capita)	-88.22	-1.13	-115.77	-1.65
Predicted local govt expd	-103.92	-16.83	-125.54	-11.42
Predicted local govt policy I	-108.38	-21.29	-123.21	-9.09
Predicted local govt policy II	-101.80	-14.71	-118.31	-4.19

[a] See related footnotes in Table 5.1. ΔPOP_b of farm population equals -87.09 percent for the full working age group and -114.12 percent for the young working age group. ΔPOP_b of nonfarm population equals 52.32 percent for the full working age group and 32.28 percent for the young working age group.

Table 5.2. (Continued)

Variables of interest (X_i)	Individuals aged 20-64		Individuals aged 20-34	
	ΔPOP_{X_i}	$\Delta POP_{X_i} - \Delta POP_b$	ΔPOP_{X_i}	$\Delta POP_{X_i} - \Delta POP_b$
Nonfarm Population Growth:				
Herfindahl index of employment	53.28	0.96	33.48	1.20
Human capital investment	55.10	2.78	32.83	0.55
Predicted farm income	7.67	-44.65	1.25	-31.03
Predicted nonfarm income	62.25	9.93	36.98	4.70
Percentage of blacks in total pop	52.97	0.65	32.82	0.54
Predicted local govt tax revenue (per capita)	41.02	-11.30	21.85	-10.43
Predicted local govt public welfare expd (per capita)	51.62	-0.70	31.48	-0.80
Predicted local govt expd	45.70	-6.62	27.26	-5.02
Predicted local govt policy I	39.37	-12.95	21.25	-11.03
Predicted local govt policy II	34.39	-17.93	16.83	-15.45

Table 5.3. Simulated cross-sectional effects of rural county population growth[a] (Numbers in percentage)

Variables of Interest (X_i)	$\Delta POP_{Xi,Min}$	$\Delta POP_{Xi,Max}$	$\Delta POP_{Xi,Max} - \Delta POP_{Xi,Min}$
Individuals aged 20-64:			
Herfindahl index of employment	25.12	0.20	-24.92
Percentage of farm pop	14.19	9.27	-4.92
Distance to a city with population > 100,000	17.32	5.84	-11.48
Human capital investment	21.70	5.49	-16.21
Obs. rural avg income	-5.24	18.68	23.92
Percentage of blacks in total population	14.66	3.74	-10.92
Predicted local govt tax revenue (per capita)	28.06	-1.57	-29.63
Pre. local govt public welfare exp (per capita)	-0.05	18.90	18.95
Predicted local govt expd	-7.26	27.29	34.55
Predicted local govt policy I	5.85	18.51	12.66
Predicted local govt policy II	9.98	14.90	4.92

[a] See related footnotes in Table 5.1. $\Delta POP_{Xi,min}$ and $\Delta POP_{Xi,max}$ are the estimated population changes when the variable of interest Xi is set to its minimum value and maximum value in the sample, holding all other variables at their 1950 levels. ΔPOP_b equals 10.82 percent for the full working age group and -3.28 percent for the young working age group.

Table 5.3. (Continued)

Variables of Interest (X_i)	$\Delta POP_{Xi,Min}$	$\Delta POP_{Xi,Max}$	$\Delta POP_{Xi,Max} - \Delta POP_{Xi,Min}$
Individuals aged 20-34:			
Herfindahl index of employment	19.01	-19.83	-38.84
Percentage of farm pop	-0.04	-4.77	-4.73
Distance to a city with population > 100,000	5.49	-10.00	-15.49
Human capital investment	17.84	-13.35	-31.19
Obs. rural avg income	-27.15	8.40	35.55
Percentage of blacks in total population	0.28	-9.83	-10.11
Predicted local govt tax revenue (per capita)	14.07	-15.75	-29.82
Pre. local govt public welfare exp (per capita)	-20.80	9.74	30.54
Predicted local govt expd	-32.04	21.54	53.58
Predicted local govt policy I	-12.59	7.23	19.82
Predicted local govt policy II	-14.69	9.07	23.76

Table 5.4. Simulated cross-sectional effects of farm and nonfarm population growth[a] (Numbers in percentage)

Variables of Interest (X_i)	$\Delta POP_{Xi,Min}$	$\Delta POP_{Xi,Max}$	$\Delta POP_{Xi,Max}$ - $\Delta POP_{Xi,Min}$
	Individuals aged 20-64: **(Individuals aged 20-34:)**		
Farm pop growth:			
Herfindahl index of employment	-98.63 (-127.46)	-78.52 (-104.21)	20.11 (23.25)
Distance to a city with population > 100,000	-88.29 (-119.27)	-86.18 (-110.18)	2.11 (9.09)
Human capital investment	-49.00 (-50.89)	-105.92 (-145.34)	-56.92 (-94.45)
Predicted farm income	-164.86 (-204.99)	-40.03 (-59.13)	124.83 (145.86)
Predicted nonfarm income	-88.74 (-110.92)	-86.12 (-116.01)	2.62 (-5.09)
Percentage of blacks in total population	-86.68 (-113.52)	-87.86 (-115.22)	-1.18 (-1.70)
Predicted local govt tax revenue (per capita)	-90.47 (-125.65)	-84.45 (-105.08)	6.02 (-20.57)
Pre. local govt public welfare exp (per capita)	-111.26 (-149.52)	-69.24 (-87.98)	42.02 (61.54)
Predicted local govt expenditure	-83.23 (-123.92)	-96.65 (-114.65)	-13.42 (9.27)

[a] See related footnotes in Table 5.3. ΔPOP_b of farm population equals -87.09 percent of the full working age group and -114.12 percent of the young working age group. ΔPOP_b of nonfarm population equals 52.32 percent of the full working age group and 32.28 percent of the young working age group.

Table 5.4. (Continued)

Variables of Interest (X_i)	$\Delta POP_{Xi,Min}$	$\Delta POP_{Xi,Max}$	$\Delta POP_{Xi,Max} - \Delta POP_{Xi,Min}$
Predicted local govt policy I	-75.24 (-126.98)	-122.29 (-126.68)	-47.05 (0.30)
Predicted local govt policy II	-86.61 (-135.45)	-94.00 (-105.61)	-7.39 (29.84)
Nonfarm pop growth:			
Herfindahl index of employment	56.03 (36.93)	49.56 (28.83)	-6.47 (-8.10)
Distance to a city with population > 100,000	62.37 (46.90)	44.62 (21.09)	-17.75 (-25.81)
Human capital investment	44.06 (30.74)	55.81 (32.95)	11.75 (2.21)
Predicted farm income	95.95 (62.61)	25.91 (13.93)	-70.04 (-48.68)
Predicted nonfarm income	35.41 (25.62)	62.28 (36.21)	26.87 (10.59)
Percentage of blacks in total population	60.70 (39.25)	36.87 (19.44)	-23.83 (-19.81)
Predicted local govt tax revenue (per capita)	70.34 (48.93)	38.19 (19.24)	-32.15 (-29.69)
Pre. local govt public welfare exp (per capita)	37.37 (14.97)	63.36 (45.07)	25.99 (30.10)
Predicted local govt expd	32.81 (10.51)	70.87 (51.85)	38.06 (41.34)
Predicted local govt policy I	42.24 (19.50)	78.12 (57.83)	35.88 (38.33)
Predicted local govt policy II	50.83 (27.15)	56.74 (38.80)	5.91 (11.65)

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APPENDIX A: DATA SOURCES AND DESCRIPTION

Data Sources

1. The 1950, 1960, 1970, 1980, and 1990 Census of Population,
2. The 1950, 1959, 1969, 1978, 1982, and 1987 Census of Agriculture,
3. The 1950, 1960, 1970, and 1980 Census of Housing,
4. The 1957, 1962, 1967, 1972, 1977, 1982, and 1987 Compendium of Government Finances,
5. The 1957, 1962, 1967, 1972, 1977, 1982, and 1987 Compendium of State Government Finances,
6. The 1950, 1960, 1970, and 1980 State Government Finances,
7. The 1952, 1962, 1972 and 1983 County and City Data Book,
8. The 1967-1968 and 1990 Digest of Education Statistics,
9. The 1954, 1961, and 1982 Statistical Abstract of the United States,
10. The 1950, 1960, 1970, and 1980 Highway Statistics,
11. U.S. Union Sourcebook,
12. The 1973 Directory of National Unions and Employee Associations,
13. The 1991 Economic Report of the President,
14. Monthly Averages for State Climatic Division 1931-1960 ,
15. The 1969 Climate-Logical Data Annual Summary, and
16. Soil survey data from the national Map Unit Interpretation Record (MUIR) database.

Data Description

The procedures used to compute the variables of the models and the means and standard deviations of the variables will be reported in the section.

Population growth

Population growth during year t-10 to year t (i.e., $M_C(t, t-10)$, $M_F(t, t-10)$, and $M_{NF}(t, t-10)$) are derived from total population, farm population, and nonfarm population. The 1950-1990 editions of Census of Population contain county data on total population, $N_C(t)$, and rural farm population, $N_F(t)$. Since rural counties are the subject of the study, nonfarm population, $N_{NF}(t)$, can be derived by subtracting farm population from total population. However, the definition of rural farm changed in the 1980 Census of Population[19]. Some members of the population who were classified as farmers in the 1970 Census may not be classified as farmers in the 1980 Census by the new definition, even if they have not moved during the decade. The definition change may result in a miscounting of farm and nonfarm populations. Special tabulations provided by the Bureau of the Census provided 1980 farm populations using the 1970 definition. This allowed percentage changes in the farm population from 1970 to 1980 to be derived under a common farm definition. However, only overall farm population were provided in the special tabulations. Farm population aged 20-64 in 1980 using the 1970 definition was estimated by

$$\frac{N_{F\ 20\text{-}64}\ (1980)}{N_{F\ \text{all ages}}\ (1980)} \approx \frac{N_{F\ 20\text{-}64}\ (1970)}{N_{F\ \text{all ages}}\ (1970)} = \alpha \qquad (A.1.1)$$

Thus,

$$N_{F\ 20\text{-}64}\ (1980) \approx \alpha\, N_{F\ \text{all ages}}\ (1980) \qquad (A.1.2)$$

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[19] The 1980 Census of Population:
"The farm population is identified only in rural areas and includes all persons living on places of one acre or more from which at least $1,000 worth of agricultural products were sold during 1979. The definition of a farm has been changed since the 1970 Census, when a farm was defined as a place of 10 acres with at least $250 worth of agricultural sales." (p. A-2)

The same method was applied to the estimation of farm population aged 20-34, $N_{F20\text{-}34}$ (1980). Since the new definition of rural farms is consistent for the 1980 and 1990 Censuses, no adjustment is needed for computing farm and nonfarm population growth for that period .

Average income

Since no direct data are available, average income is defined as median family income divided by persons per family. The 1950-1980 Census of Population contain most of the data on income. However, a few problems exist in the data source:

1. The 1950 Census of Population does not report median family income by farm and nonfarm residence.

2. The 1960-1980 Census of Population does not contain median family income of nonfarm population.

3. County-level information on persons per family does not exist in the 1960 and 1970 Census of Population.

To solve the problems, the following procedures were performed:

1. Median income of families and unrelated individuals[20] is used for the 1950 average county income of total population and nonfarm population (The terms county income and nonfarm income will be used, hereafter.)

2. The 1950 average county income of farm population (The term farm income will be used, hereafter) is derived from county income and nonfarm income, which are weighted by shares of farm and nonfarm population. That is,

County average income = (share of farm population) (farm average income) + (share of nonfarm population) (nonfarm average income), (A.2)

or in notation,

$$Y = (F/T)\ (Y_F) + (NF/T)\ (Y_{NF}) \qquad (A.2.1)$$

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[20] It is not deflated by persons per family because unrelated individuals are included.

where Y = county average income
Y_F = farm average income
Y_{NF} = nonfarm average income
T = total population in a county
F = farm population in a county
NF = nonfarm population in a county.

Thus,

$$Y_F = \frac{Y - (NF/T)(Y_{NF})}{(F/T)} \qquad (A.2.2)$$

3. As the 1950 farm income, the 1960-1980 nonfarm income are derived from weighted county income and farm income. That is,

$$Y_{NF} = \frac{Y - (F/T)(Y_F)}{(NF/T)} \qquad (A.2.3)$$

4. Persons per family in 1960 and 1970 is estimated by total population minus unrelated individuals divided by number of families. That is,

$$\text{Persons per family} = \frac{\text{Total population - Unrelated individuals}}{\text{Number of families}} \qquad (A.3)$$

However, there is not enough information for computing persons per family for the 1960 farm families. In that year, county-wide persons per family is used instead.

Distance to big cities

Distance to a city was measured in three ways. The first measure was distance from the center of a rural county to its nearest city which had a population of at least 25,000 in 1950. The second measure was the distance to the nearest city of population at least 100,000 in 1950. The third measure was to the nearest city with a population of at least 100,000 at the start of every decade from 1950-1980. To prevent problems of endogeneity, only 1950 population is used to define big cities . That is, only the second measure is used in the preferred models. Maps in the 1950 Census of Population which indicate qualified cities and a U.S. map with county-division are used to measure the distance.

Human capital investments

Median school years completed for those aged 25 and over and percentage of population of age 25 years old and over with at least high school degree are used as measures of human capital investments in a county. The 1952, 1962, and 1972 County and City Data Book provide the data of 1950, 1960, and 1970 median school years completed , the 1980 data comes from the 1980 Census of Population. Percentage of population with at least a high school degree is derived from Census of Population data. It is the sum of males and females 25 years old and over who have finished at least four years of high school divided by the sum of males and females of 25 years old and over.

Government policy

The ideal measures of government expenditure[21] in a county would be the sum of federal, state, and local government[22] expenditures. However, there is no county data available for state or federal government finances. In addition, state government finance is exogenously determined, while local government expenditures may be set in part by observed migration patterns. Therefore, state and local government finances will be

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[21] "The sharing of financing responsibility between the state government and its local governments differs from one function to another inside each state. " (Gardner, 1978, p.289)

[22] According to the 1957 Census of Government vol. 1: government organization, local governments consist of school districts, counties, municipalities and townships, and special districts.

used separately in regressions. It is assumed that state governments distribute expenditures equally to each county.

The following state and local government policy have been considered in the government policy vector(GOVT):

(1) Local government policy: per capita general revenue, per capita intergovernmental revenue, per capita general expenditure, per capita education expenditure, per capita public welfare expenditure, per capita tax revenue, per capital debt outstanding, per capita long-term debt outstanding, and highway expenditure, and

(2) State government policy: per capita education expenditure, per capita public welfare expenditure, highway expenditure.

For preventing the problems of multicollinearity and following the principle of parsimony, only the most important local government policies, which are expenditures in education, public welfare, and highway, tax revenue, and long-term debt outstanding, and state government highway expenditure, are used.

Local government data comes from the Compendium of Government Finances which was published every five years since 1957. State government highway expenditure data (state level) comes from the Compendium of State government Finances. The highway data is available on an annual basis, but only the 1957, 1962, 1967, 1972, 1977, 1982, and 1987 data are used to be consistent with the available local government data. To prevent endogeneity of local government policy due to simultaneity of migration and policy, local government policy is predicted using information available at the start of each decade.

Local government policy instruments

Vector X_2 in equation (3.14), which is used to predict local government policy, includes the following elements:

1. **Per capita state government tax revenue** Per capita state government tax revenue is reported in the 1950, 1960, 1970, and 1980 State Government Finances. All data are at the state level.

2. **Percentage of low income families** The percentage of low income families is derived from the data in the 1950, 1960, 1970, and 1980 Census of Population. Since the first class of family income reported in the 1980 Census of Population is for families with income less than 5,000 dollars, low income families are defined as those families with income less than 5,000 1980 dollars. Deflated by Consumer Price Index (1982-1984 = 100), $5,000 in 1980, respectively, were $1,462.38, $1,796.12, and $2,354.37 in 1950, 1960, and 1970. Because of the classification of family income reported in the Censuses, families in 1950 with income less than $1,500, families in 1960 with income less than $1,999, and families in 1970 with income less than $1,999 and half of the families in 1970 with income between $2,000 and $2,999 were classified as low income families in the study.

3. **Average annual instructors' salary** The average annual salary of instructional staff in full-time public elementary and secondary day schools is available at the state level for 1950, 1960, 1970, and 1980. The data are reported in the 1967-1968 and the 1990 Digest of Education Statistics . This is used as a measure of cost of providing educational services.

4. **Per mile cost of rural roads** The per mile cost of primary and secondary rural roads are reported in the 1950, 1960, 1970, and 1980 Highway Statistics. This is used as a measure of cost of providing road services.

5. **Federal funds per mile** The federal funds per mile of federal-aid highway projects are available on a per state basis in the 1950, 1960, 1970, and 1980 Highway Statistics.

6. **Union membership** Conversation with transportation engineers indicated that union density was correlated with public sector labor costs in construction. (1) The 1950, 1960 and 1980 union membership as a percentage of employees in nonagricultural establishments are derived from the 1954, 1961, and 1982 Statistical Abstract of the United States and U.S. Union Sourcebook and (2) The 1970 data comes from the 1973 Directory of National Unions and Employee Associations. State average were used unless the county was on a state border. Average union membership in both states were used for border counties, since border counties may be influenced by unions in both states.

7. **Road suitability** Measures of soil suitability for road construction are based on average subcounty limitation ratings for "Local roads and streets" (GRP10) and "Roadfill" (GRP12) are used to measure road suitability in rural counties. GRP10 of 6, 3, and 5 represents a "slight" limitation, a "moderate" limitation, and a "severe" limitation, respectively. GRP12 of 2, 1, and 4 represents a "good" limitation, a "fair" limitation, and a "poor" limitation, respectively. For convenience, the limitation ratings were re-rated from one to three, with three being the highest suitability and one being the least suitable. Measures of soil suitability for road construction are based on a soil survey data from the national

Map Unit Interpretation Record (MUIR) database. There were twenty counties which lacked limitation ratings. Those missing ratings were replaced by average limitation ratings in either adjacent counties or in the same major land resource area.

Diversity in industry mix

A Herfindahl index of employment is used as a measure of industrial diversity in a county. The proportion of an industry's employment relative to total county employment is used as a measure of market share for that industry. The employed population in the 1950, 1960, 1970 and 1980 Census of Population are grouped into the following ten industries. They are:

a. agriculture, forestry, and fisheries,
b. mining,
c. construction,
d. manufacturing,
e. transportation, communications, and other public utilities,
f. wholesale trade,
g. retail trade,
h. finance, insurance, and real estate,
i. services, and
j. public administration.

The Herfindahl index of employment is constructed as

$$HIDX = \sum_{w=1}^{j} S_w^2 \qquad (A.4)$$

where S_w is the employment share of industry w, w = 1,2, ...,j. The index approaches zero if each industry has an equal share and equals one if there is only one industry in the county[23]. Therefore, higher values of HIDX imply less diversity.

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[23] In log form the Herfindahl index of employment varies between minus infinity and zero.

Cost of living

According to the definition of gross monthly rent in the 1950-1980 Census of Housing[24], median gross monthly rent can be used as a rough measure of the cost of living. However, the 1950 Census of Housing reports rents for urban and rural-nonfarm areas of a county, while the 1960-1980 Census of Housing reports gross rent for the county as a whole. The 1950, 1960, and 1970 Census of Housing had some missing data. The missing data are replaced by average median gross monthly rent in adjacent rural counties.

Agriculture productivity

Agriculture production will rise with the size of the farm because of the larger number of inputs. Large farms may also be able to operate more efficiently than small farms. High productivity in farms could also raise the value of the land and buildings. Hence, the average size of farm and the average value of land and buildings per acre are used as measures of agriculture productivity. Average size of farm and average value of land and buildings per acre are reported in the Census of Agriculture. The 1950, 1959, 1969, 1978, 1982 and 1987 Census of Agriculture are used. The 1980 information is assumed to be the average of the 1978 and 1982 Census of Agriculture data. The estimated values of 1978 (1982) missing data are based on the information in the 1982 (1978) and 1987 Census of Agriculture. The definition of farm has been changed nine times since 1850 when minimum criteria defining a farm first were established in the Census of Agriculture. During the forty years of this study, the farm definition was

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[24] Gross rent is the contract rent plus the estimated average monthly cost of utilities (electricity, gas, and water) and fuels (oil, coal, kerosene, wood, etc.) if these are paid for the renter (or paid for the renter by someone else) in addition to rent.

changed twice[25]. Thus, three period dummy variables were used to correct for the definition changes.

Product mix

Crops and livestock are two major types of agricultural product. The value of all crops sold divided by the value of all farm products sold is used to measure the degree of agricultural production concentrated on crops. The data source and the estimation method are the same as those for agriculture productivity.

Price index

For comparability of data over time, all currency related data are deflated by the Consumer Price Index, CPI (1982-1984 = 100), which is reported in the 1991 Economic Report of the President. Although price level may vary between urban and rural counties or vary across rural counties, there is no suitable price index available.

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[25] During the period of study, the farm definition was changed twice. One was in 1959 and one was in 1974. Therefore, three farm definitions were used in the forty-year period.
(1) The 1959 Census of Agriculture:
"For both the 1950 and 1954 Census of Agriculture, places of 3 or more acres were counted as farms if the annual value of agricultural products, whether for home use or for sale but exclusive of home-garden products, amounted to $150 or more. Places of less than 3 acres were counted as farm only if t he annual sales of agricultural products amounted to $150 or more. A few places with very low agricultural product because of unusual circumstances, such as crop failure, were also counted as farms if they normally could have been expected to meet the minimum value or sales criteria." (p. XV)
(2) The 1959 Census of Agriculture:
"Places of less than 10 acres in 1959 were counted as farms if the estimated sales of agricultural products for the year amounted to at least $250. Places of 10 or more acres in 1959 were counted as farms if the estimated sales of agricultural products for the year amounted to at least $50. Places having less than the $50 or $250 minimum estimated sales in 1959 were also counted as farms if they could normally be expected to produce agricultural products in sufficient quantity to meet the requirements of the definition." (p. XIV)
(3) The 1987 Census of Agriculture: "...any place from which $1,000 or more of agricultural products were produced and sold or normally would have been sold during the Census year." (p. VII)

Therefore, controls for hedonic attributes such as weather variables and median gross monthly rent were used in regressions to control for reflect price differences across counties.

Table A.1. The means and standard deviations of the models in the study[a] (Numbers in log term)

Variables	Means	Standard deviations
Median school years completed	2.29	0.18
percentage of pop with high school degree	3.56	0.48
Herfindahl index of employment	-1.56	0.30
Observed rural county average income	8.55	0.44
Predicted rural county average income	8.34	0.40
Observed farm income	8.48	0.53
Predicted farm income	8.25	0.48
Observed nonfarm income	8.59	0.41
Predicted nonfarm income	8.44	0.34
Percentage of farm population	-1.50	0.88
Average size of farm	5.55	0.86
Value of land and buildings per acre	6.32	1.05
Value of crop products sold / Value of total products sold	3.35	0.90
Distance to a city with pop > 100,000	4.48	0.72
Median gross monthly rent	5.16	0.36
Average January temp (1931-1960)	3.30	0.57

[a] Number of observations is 1224 for all variables, but is 1203 for observed farm and nonfarm income.

[b] Data of union membership is in modified state level. That is, in general, state level data were used, but average state level was used for those counties in border of states.

Table A.1. (Continued)

Variables	Means	Standard deviations
Average July temp (1931-1960)	4.34	0.05
Average annual rainfall (1931-1960)	3.54	0.40
Percentage of blacks in total population	-0.63	2.57
Percentage of pop less than 15 years old	0.29	0.05
Percentage of farm pop < 15 years old	0.29	0.08
Percentage of nonfarm pop < 15 years old	0.28	0.05
Percentage of pop 65 years old and over	0.12	0.04
Percentage of farm pop ≥ 65 years old	0.10	0.04
Percentage of nonfarm pop ≥ 65 years old	0.14	0.05
Predicted per capita local govt tax revenue	5.57	0.68
Predicted per capital local govt LR debt outstanding	6.06	0.49
Predicted per capital local govt public welfare expenditure	-10.34	1.68
Predicted per capita local govt education expenditure	5.91	0.44
Predicted local govt highway expenditure	7.12	0.67
Observed state govt highway expenditure (State level)	13.01	0.58
Per capita state govt tax revenue (State level)	5.99	0.45

Table A.1. (Continued)

Variables	Means	Standard deviations
Percentage of low income family	2.92	0.68
Average annual instructors' salary (State level)	8.93	0.31
Per mile cost of rural roads, primary (State level)	6.31	0.93
Per mile cost of rural roads, secondary (State level)	4.93	1.04
Federal funds per mile (State level)	3.55	0.74
Union membership (State level[b])	3.09	0.37
Average subcounty limitation ratings, local roads and streets	0.27	0.19
Average subcounty limitation ratings, roadfill	0.41	0.23

APPENDIX B. THE EFFECTS OF INCOME COMPONENTS ON POPULATION GROWTH

In order to capture the effect on population growth of the income components, observed county income and predicted farm and nonfarm income in chapter 4 were decomposed into income components as described in equation (3.10). With income components as regressors, the regressions of county population changes as equation (3.11) and the regressions of farm and nonfarm population changes as equation (3.13) are performed. The results of the regressions of county population changes and those of farm and nonfarm population changes are shown in Table B.1 and Table B.2, respectively. Forty-five to fifty-one percent of variation in county population growth, forty-two to forty-six percent of variation in farm population growth, and thirty-two to thirty-four percent of variation in nonfarm population growth is explained by the corresponding regressions. The regressions have more power to explain population changes for the young working age group than for the full working age group and more power for explaining farm population changes than nonfarm population changes.

Table B.1. Regressions of county population growth rate with income components as regressors

Explanatory Variables	Individuals aged 20-64	Individuals aged 20-34
Intercept	1.04 (0.62)[a]	0.38 (0.17)
Median school years completed	-0.16 (-2.13)	-0.34 (-3.31)
Percentage of population with high school degree	0.00 (0.06)	0.03 (0.62)
Herfindahl index of employment	-0.12 (-3.02)	-0.20 (-3.56)
Ptge of farm population	-0.02 (-1.68)	-0.02 (-1.29)
Average size of farm	-0.02 (-1.84)	-0.01 (-0.83)
Value of land & buildings per acre	-0.01 (-0.63)	0.01 (0.53)
Value of crop prdt sold / Value of total prdt sold	-0.03 (-4.86)	-0.05 (-4.71)
Distance to a city with population > 100,000	-0.04 (-3.77)	-0.05 (-3.41)
Median gross monthly rent	0.13 (2.87)	0.15 (2.81)
Average January temp (1931-1960)	0.10 (2.53)	0.08 (1.65)
Average July temp (1931-1960)	-0.05 (-0.13)	0.11 (0.22)
Average annual rainfall (1931-1960)	-0.10 (-1.45)	-0.01 (-0.17)
Percentage of blacks in total population	-0.01 (-1.93)	-0.00 (-0.57)

[a] t-values are in the parentheses.

Table B.1. (Continued)

Explanatory Variables	Individuals aged 20-64	Individuals aged 20-34
Unexplained local income differential (ε_R)	0.11 (1.30)	0.18 (1.63)
Percentage of population less than 15 years old	-0.01 (-0.08)	-0.12 (-1.08)
Percentage of population 65 years old and over	-0.03 (-0.75)	-0.03 (-0.66)
Predicted local govt tax revenue (per capita)	-0.11 (-3.89)	-0.11 (-2.86)
Predicted local govt edu expenditure (per capita)	-0.02 (-0.31)	0.02 (0.24)
Predicted local govt LR debt outstanding (per capita)	0.05 (1.00)	0.01 (0.19)
Predicted local govt public welfare expd (per capita)	0.02 (1.84)	0.03 (2.04)
Predicted local govt highway exp (county level)	0.02 (1.44)	0.02 (1.07)
State govt highway expenditure (state level)	-0.04 (-3.16)	-0.06 (-3.48)
Shannon county dummy	0.28 (3.84)	0.42 (4.84)
1950s dummy	-0.19 (-2.84)	-0.17 (-1.87)
1960s dummy	-0.02 (-0.56)	0.14 (2.83)
1970s dummy	0.10 (4.95)	0.22 (8.75)
F-VALUE	37.25	48.80
R^2	0.45	0.51

Table B.2. Regressions of farm and nonfarm population growth rate with income components as regressors

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Intercept	-6.80 (-3.00)[a]	0.54 (0.31)	-5.57 (-1.78)	0.48 (0.21)
Median school years completed	-0.15 (-0.92)	0.01 (0.11)	-0.44 (-2.11)	-0.13 (-1.02)
Percentage of population with high school degree	-0.06 (-0.77)	-0.05 (-0.97)	-0.09 (-0.94)	-0.02 (-0.34)
Distance to a city with population > 100,000	-0.01 (-0.46)	-0.05 (-4.00)	0.01 (0.27)	-0.07 (-4.22)
Herfindahl index of employment	0.08 (2.08)	-0.04 (-1.18)	0.10 (1.90)	-0.04 (-0.89)
Percentage of pop less than 15 years old	-0.25 (-3.25)	0.12 (1.71)	-0.52 (-4.97)	0.01 (0.14)
Percentage of pop 65 years and over	-0.10 (-2.93)	-0.05 (-1.41)	-0.14 (-2.28)	-0.03 (-0.63)
Predicted local govt tax revenue (per capita)	0.12 (1.97)	-0.15 (-3.46)	0.20 (2.38)	-0.13 (-2.51)
Predicted local govt edu expenditure (per capita)	-0.10 (-1.26)	-0.08 (-1.44)	-0.05 (-0.43)	-0.05 (-0.68)
Predicted local govt LR debt outstanding (per capita)	-0.08 (-1.44)	0.10 (2.16)	-0.05 (-0.71)	0.09 (1.74)
Predicted local govt public wel expend (per capita)	0.04 (2.13)	0.03 (2.37)	0.06 (2.25)	0.04 (2.00)
Predicted local govt highway expenditure	-0.15 (-4.59)	0.04 (2.12)	-0.16 (-3.69)	0.02 (0.99)
State govt highway expenditure (State level)	0.04 (1.77)	-0.03 (-2.22)	-0.01 (-0.50)	-0.04 (-2.15)

[a] t-values are in the parentheses and have been corrected for heteroskedasticity.

Table B.2. (Continued)

Explanatory variables	Individuals aged 20-64		Individuals aged 20-34	
	Farm pop	Nonfarm pop	Farm pop	Nonfarm pop
Ptge of blacks in total population	-0.01 (-2.58)	-0.01 (-2.55)	-0.02 (-2.15)	-0.01 (-1.06)
Percentage of farm population	-0.13 (-5.66)	0.09 (7.08)	-0.16 (-4.88)	0.08 (5.77)
Average size of farm	0.03 (1.21)	-0.06 (-4.15)	0.03 (0.93)	-0.05 (-2.58)
Value of land and buildings per acre	0.09 (4.17)	-0.06 (-4.39)	0.09 (3.30)	-0.04 (-2.78)
Value of crop prdt sold / Value of total prdt sold	-0.04 (-4.03)	-0.03 (-3.62)	-0.05 (-3.74)	-0.05 (-4.02)
Median gross monthly rent	0.30 (5.20)	0.02 (0.39)	0.34 (4.20)	0.03 (0.59)
Avg Jan temperature (1931-1960)	-0.22 (-2.41)	0.21 (2.72)	-0.12 (-0.98)	0.19 (2.08)
Avg July temperature (1931-1960)	1.07 (2.05)	0.45 (1.18)	0.55 (0.77)	0.40 (0.79)
Avg annual rainfall (1931-1960)	0.21 (2.14)	-0.16 (-2.21)	0.36 (2.60)	-0.10 (-1.08)
Shannon county dummy	-0.21 (-0.63)	0.23 (2.53)	0.08 (0.22)	0.35 (2.89)
1950s dummy	0.25 (3.23)	-0.44 (-8.29)	0.18 (1.77)	-0.39 (-5.85)
1960s dummy	0.28 (4.76)	-0.22 (-5.43)	0.35 (4.49)	0.00 (0.05)
1970s dummy	0.40 (10.12)	-0.04 (-1.78)	0.54 (0.03)	0.08 (3.06)
F value	34.14	22.95	40.62	24.70
R^2	0.42	0.32	0.46	0.34

APPENDIX C: THE REGRESSIONS OF PREDICTED LOCAL GOVERNMENT POLICY

To correct for possible endogeneity of local government policy due to simultaneous determination with migration pattems, two stages least squares were used to predict local govemment policy measures eompolyed in the second stage regressions of population growth rates. The results of the first-stage predicted local government policy regressions are reported in Table C.1. The models fit the data very well. Excepercentfor the regression explaining local government long term debt outstanding (R^2 equals 0.20), all regressions have a R^2 higher than 0.47.

Table C.1. Regressions of predicted local government policy

Explanatory variables	Public welfare expenditure (per capita)	Highway expenditure	Tax revenue (per capita)
Intercept	94.62 (9.37)[a]	10.73 (2.97)	-0.84 (-0.44)
Migration related variables:			
Herfindahl index of employment	0.38 (1.20)	-0.23 (-2.02)	0.05 (0.85)
Percentage of farm population	0.21 (1.75)	0.05 (1.09)	0.09 (4.00)
Distance to a city with population > 100,000	-0.32 (-2.19)	-0.20 (-3.78)	-0.03 (-0.98)
Median school years completed	2.90 (2.27)	-1.07 (-2.35)	-0.42 (-1.74)
Percent of pop with high school degree	0.79 (1.31)	1.40 (6.49)	0.86 (7.54)
Observed average income in R	0.69 (1.21)	0.24 (1.19)	0.37 (3.45)
Percent of pop less than 15 years old	3.96 (5.63)	1.67 (6.64)	1.28 (9.66)
Percent of pop of age 65 and over	1.27 (3.54)	0.20 (1.56)	0.69 (10.15)
Percent of blacks in total population	0.20 (4.46)	0.06 (3.50)	0.01 (1.15)
Avg Jan temp (1931-1969)	-0.15 (-0.52)	-0.55 (-5.36)	-0.00 (-0.08)

[a] t-values are in the parentheses.

Table C.1. (Continued)

Explanatory variables	Public welfare expenditure (per capita)	Highway expenditure	Tax revenue (per capita)
Avg July temp (1931-1969)	-20.63	-1.61	0.27
	(-8.85)	(-1.93)	(0.61)
Avg annual rainfall (1931-1969)	-1.37	1.31	-0.58
	(-3.10)	(8.26)	(-7.04)
Nonmigration related variables:			
Avg annual salary of instructors	0.65	0.52	1.03
	(0.99)	(2.22)	(8.35)
Per capita state govt tax rev	-1.25	-0.16	-0.61
	(-3.21)	(-1.18)	(-8.38)
Percent of low income families in county	-0.08	-0.32	-0.19
	(-0.24)	(-2.55)	(-2.88)
Union membership/nonagr emp	0.28	-0.38	-0.11
	(0.91)	(-3.37)	(-1.93)
Per mile cost of primary rural road	0.39	-0.03	0.18
	(2.55)	(-0.63)	(6.14)
Per mile cost of secondary rural rd	-0.34	-0.22	-0.16
	(-2.78)	(-5.18)	(-7.13)
Fed funds per mile of fed-aid hwy	-0.81	-0.36	0.11
	(-4.40)	(-5.47)	(3.05)
Limitation rating for local rd and st	-0.79	0.52	0.15
	(-1.62)	(2.95)	(1.59)
Limitation rating for roadfill	0.37	0.00	-0.11
	(0.92)	(0.01)	(-1.45)

Table C.1. (Continued)

Explanatory variables	Public welfare expenditure (per capita)	Highway expenditure	Tax revenue (per capita)
Extra effects for year 1957, 1967, 1977, and 1987:			
Herfindahl index of employment	-0.07 (-0.18)	-0.08 (-0.59)	-0.40 (-0.54)
Percentage of farm population	-0.27 (-1.66)	0.02 (0.27)	-0.03 (-0.86)
Distance to a city with population > 100,000	-0.00 (-0.01)	-0.02 (-0.25)	-0.00 (-0.06)
Median school years completed	-2.09 (-1.32)	-1.09 (-1.93)	-0.32 (-1.09)
Percent of pop with high school degree	1.62 (2.22)	0.15 (0.57)	0.05 (0.37)
Observed average income in R	-1.01 (-1.65)	0.00 (0.02)	0.09 (0.78)
Percent of pop less than 15 years old	-1.76 (-1.84)	-0.17 (-0.49)	-0.29 (-1.59)
Percent of pop of age 65 and over	-0.61 (-1.29)	-0.00 (-0.02)	-0.12 (-1.34)
Percent of blacks in total population	-0.14 (-2.46)	-0.03 (-1.65)	-0.01 (-1.04)
Avg Jan temp (1931-1969)	-0.62 (-1.90)	-0.05 (-0.43)	-0.04 (-0.69)
Avg July temp (1931-1969)	3.15 (1.60)	0.38 (0.53)	0.56 (1.51)

Table C.1. (Continued)

Explanatory variables	Predicted public welfare expend (per capita)	Predicted highway expend	Predicted tax revenue (per capita)
Avg annual rainfall (1931-1969)	0.32 (0.55)	0.25 (1.19)	-0.02 (-0.22)
Avg annual salary of instructors	-1.89 (-2.40)	-0.26 (-0.90)	-0.37 (-2.51)
Per capita state govt tax rev	0.51 (1.01)	0.20 (1.09)	0.08 (0.89)
Percent of low income families in county	0.13 (0.32)	-0.08 (-0.50)	0.07 (0.93)
Union membership/nonagr emp	0.53 (1.33)	0.03 (0.24)	-0.04 (-0.53)
Per mile cost of primary rural road	0.41 (2.01)	0.02 (0.33)	-0.04 (-1.11)
Per mile cost of secondary rural rd	-0.23 (-1.45)	-0.02 (-0.43)	0.03 (1.13)
Fed funds per mile of fed-aid hwy	0.19 (0.82)	0.15 (1.82)	-0.03 (-0.79)
Limitation rating for local rd and st	0.45 (0.70)	0.10 (0.44)	-0.10 (-0.86)
Limitation rating for roadfill	-0.18 (-0.33)	0.08 (0.42)	-0.00 (0.00)
F-value	44.35	43.72	144.02
R^2	0.47	0.47	0.74

Table C.1. (Continued)

Explanatory variables	Education expenditure (per capita)	Long-term debt outstanding (per capita)
Intercept	-5.44 (-3.94)	-11.93 (-2.34)
Migration related variables:		
Herfindahl index of employment	-0.14 (-3.18)	-0.26 (-1.63)
Percentage of farm population	-0.01 (-0.41)	0.07 (1.18)
Distance to a city with population > 100,000	0.04 (2.16)	0.02 (0.25)
Median school years completed	0.41 (2.34)	-1.26 (-1.95)
Percent of pop with high school degree	0.06 (0.77)	-0.13 (-0.43)
Observed average income in R	0.02 (0.27)	1.55 (5.44)
Percent of pop less than 15 years old	0.75 (7.75)	1.43 (4.02)
Percent of pop of age 65 and over	0.23 (4.77)	0.15 (0.83)
Percent of blacks in total population	0.00 (0.03)	0.04 (1.83)
Avg Jan temp (1931-1969)	-0.07 (-1.91)	-0.61 (-4.21)
Avg July temp (1931-1969)	1.02 (3.20)	3.16 (2.69)
Avg annual rainfall (1931-1969)	-0.22 (-3.56)	0.67 (3.01)

Table C.1. (Continued)

Explanatory variables	Education expenditure (per capita)	Long-term debt outstanding (per capita)
Nonmigration related variables:		
Avg annual salary of instructors	0.71 (7.86)	-0.53 (-1.61)
Per capita state govt tax rev	0.24 (4.45)	0.25 (1.27)
Percent of low income families in county	-0.07 (-1.54)	-0.17 (-1.00)
Union membership/nonagr emp	-0.15 (-3.63)	0.05 (0.34)
Per mile cost of primary rural road	0.04 (1.69)	0.09 (1.16)
Per mile cost of secondary rural rd	0.01 (0.75)	-0.09 (-1.42)
Fed funds per mile of fed-aid hwy	0.03 (1.18)	-0.16 (-1.68)
Limitation rating for local rd and st	0.01 (0.10)	0.02 (0.08)
Limitation rating for roadfill	0.05 (0.92)	0.00 (0.00)
Extra effects for year 1957, 1967, 1977, and 1987:		
Herfindahl index of employment	0.04 (0.72)	-0.27 (-1.34)
Percentage of farm population	0.00 (0.03)	-0.05 (-0.63)
Distance to a city with population > 100,000	-0.01 (-0.26)	0.01 (0.15)

Table C.1. (Continued)

Explanatory variables	Education expenditure (per capita)	Long-term debt outstanding (per capita)
Median school years completed	-0.34 (-1.55)	-0.15 (-0.19)
Percent of pop with high school degree	0.13 (1.33)	0.71 (1.92)
Observed average income in R	-0.08 (-1.01)	-1.24 (-4.01)
Percent of pop less than 15 years old	-0.08 (-0.59)	-0.50 (-1.03)
Percent of pop of age 65 and over	-0.06 (-0.91)	0.03 (0.14)
Percent of blacks in total population	-0.00 (-0.58)	-0.03 (-0.85)
Avg Jan temp (1931-1969)	-0.03 (-0.60)	-0.39 (-2.37)
Avg July temp (1931-1969)	0.43 (1.58)	1.35 (1.35)
Avg annual rainfall (1931-1969)	0.06 (0.73)	0.73 (2.52)
Avg annual salary of instructors	-0.05 (-0.43)	0.49 (1.22)
Per capita state govt tax rev	-0.06 (-0.92)	-0.51 (-2.01)
Percent of low income families in county	0.03 (0.44)	-0.45 (-2.14)