A life-cycle empirical analysis of migration and climate, by race

Graves, Philip E.

University of Colorado

1979

JOURNAL OF URBAN ECONOMICS 6, 135–147 (1979)

A Life-Cycle Empirical Analysis of Migration and Climate, by Race

PHILIP E. GRAVES

University of Chicago

Received February 7, 1977; revised May 2, 1977

1. INTRODUCTION AND APPROACH

The importance of climate as a determinant of net migration between areas has been noted in recent theoretical and empirical studies (Cebula and Vedder [3], Graves [5, 6], Liu [12, 13]). However, in none of these studies was the analysis disaggregated by age. Becker [1] hypothesized that age should be negatively related to migration due to the longer stream of discounted benefits obtainable and this expectation was verified empirically by Wertheimer [19]. Further, Gallaway [4] notes that this effect is strengthened if security and family ties are more important for older than for younger individuals.

That climate should figure prominently in the migration decision over the life cycle appears obvious and casual empiricism bears this out with retirees migrating to, e.g., Florida or Arizona. Yet, formal analysis of the relationship between migration, climate, and economic opportunity over the life cycle (by race) has not heretofor been carried out.

The approach taken here views each city, particularly in a country as geographically diverse as the United States, as supplying particular goods which are specific to it. That is, one city may supply bad weather but with compensating high incomes, while another supplies good weather with low incomes (see Linneman and Graves [11]) and perhaps high unemployment rates. This idea of compensating differentials goes back at least to Adam Smith and, more recently, has been applied to local public goods in the seminal work of Tiebout [16].

In this context, migration emerges as a result of changed demands for goods which can only be exercised by relocating. As with ordinary goods, the changed demands for location-specific goods result principally from changed relative prices and changed incomes, with age being in this application, an important shifter along with race. For example, an un-

0094-1190/79/020135-13$02.00/0

anticipated rise in income will result in an increased demand for leisure activity on the part of an individual. Since the leisure activity may involve outdoor recreation (golf, tennis, skiing, etc.), one would expect revised demands for the climate most amenable to such outdoor activities. The assumption here then is that the rising incomes over the 1960 to 1970 period have led to changed demands for certain aspects of climate. Hence, those SMSAs supplying climates with positive income elasticities receive more net immigration than those with inferior climate attributes. If, for example, low humidity has a positive income elasticity then SMSAs supplying low humidity would be expected, *ceteris paribus,* to have higher net in-flows over a period of generally rising incomes.

The data used to explore the migration-climate-economic opportunity relationship over the life cycle are described in Section 2. Section 3 presents the empirical results by race and Section 4 summarizes the main findings and notes their implications in a policy setting.

2. DATA

The unit of geographic area chosen as most appropriate for this analysis was the Standard Metropolitan Statistical Area (SMSA). A larger unit (e.g., state or region) was undesirable in view of the diversity of climates represented within its borders. That is, one could move to California from Nebraska and it would be impossible to determine whether the migrant was moving to a colder and wetter area or to a warmer and drier area. Since most SMSAs are multi-county, the county could have been used as a unit, however many SMSAs report their climate means and normals from only one reporting station, so the same climate would be assigned to the counties composing such SMSAs in any event. Further, SMSAs tend to better represent the extent of the labor market than do counties.

The definition of net migration used here is that followed by Bowles, Beale and Lee [2].[1] The measures of economic opportunity employed are 1960 median income for the SMSA (MEDINC) and the 1960 unemployment rate (UNEMP). Greenwood and Sweetland [8] show that using end-of-period income definitions would have resulted in a downward bias (migration over the period affecting income as well as conversely) in the estimated income coefficient. These authors suggest that the lack of significance of income in many migration analyses may be

[1] In brief, the census-survival preliminary net migration estimates for age-color groups were adjusted by the vital-statistics method to arrive at more accurate figures. These net migration estimates are expressed as percentages of the 1970 expected survivors of the 1960 population plus births during the decade.

due to this bias. As will become apparent a far simpler supplementary explanation for the low size and significance of the income and unemployment coefficient emerges from the present analysis.

The weather variables are, where possible, 1931 to 1960 means or normals. This treatment is preferable to using 1960 figures since that year was atypical for many SMSAs. The expected weather is assumed to be the concern of a potential migrant.

Two of the three temperature variables, Warmth and Cold, are expressed as degree days, 65°F base. That is, a day in which the average temperature is 50°F would receive 15 heating degree days and zero cooling degree days, while a day in which the average temperature was 80°F would be recorded as having zero heating degree days and 15 cooling degree days. Each of the annual variables is created by summing the respective degree days over the entire year. These measures of Warmth and Cold better capture peoples' perceptions of an area's temperature than do the measures which have been used by others (number of days temperature is greater than 90° or less than 32°F, etc.).

With the idea that many people might prefer either a cold climate or a warm climate but would not like to have much annual variance, a

TABLE 1

Summary Statistics for the 137 SMSAs for which Climate Data was Available

Variable	Mean	*SD*	Variable	Mean	*SD*
WTEMIG All	2.93	12.85	BLKMIG All	8.93	19.59
WTEMIG 20–24	9.31	34.54	BLKMIG 20–24	42.67	129.63
WTEMIG 25–29	12.77	27.88	BLKMIG 25–29	27.84	60.64
WTEMIG 30–34	6.89	23.86	BLKMIG 30–34	8.85	32.17
WTEMIG 35–39	2.66	17.24	BLKMIG 35–39	5.23	21.04
WTEMIG 40–44	2.42	13.74	BLKMIG 40–44	3.93	15.56
WTEMIG 45–49	1.80	12.07	BLKMIG 45–49	4.37	13.12
WTEMIG 50–54	1.73	10.51	BLKMIG 50–54	5.25	15.76
WTEMIG 55–59	1.35	10.11	BLKMIG 55–59	5.41	14.69
WTEMIG 60–64	1.45	13.83	BLKMIG 60–64	6.05	19.09
WTEMIG 65–69	1.44	19.41	BLKMIG 65–69	8.58	27.18
WTEMIG 70–74	1.94	16.86	BLKMIG 70–74	7.69	44.69
WTEMIG 75–up	4.05	11.30	BLKMIG 75–up	10.65	32.23
MEDINC 1960	5783.05	782.06			
UNEMP 1960	5.027	1.426			
Warmth	1475.72	955.76			
Cold	4422.11	2154.05			
ANTMVR	60.955	10.469			
ANNWND	9.1775	1.6251			
ANNHUM	59.543	8.892			

variable was created to measure annual temperature variance. Annual temperature variance (ANTMVR) was formed by subtracting the average daily minimum January temperature from the average daily maximum July temperature.

The final two climate variables selected for inclusion are humidity and wind velocity. An average of January and July humidity at various times during the day (ANNHUM) and the January and July average wind speed (ANNWND) were felt to be important since they are commonly reported by weathermen in the temperature and humidity comfort index and the wind and temperature chill factors.

Table 1 reports the summary statistics for all variables used in the analysis. Of particular note is the lack of any large net migration increase at retirement as well as the generally steady decline of net migration with age. Nonwhite net migration between SMSAs is much higher in all age brackets, with perhaps the most pronounced difference occurring in the 20 to 25 year-old age bracket.

TABLE 2

Net Migration, by Race. Not Disaggregated by Age.
t-values in Parentheses. 137 Observations

Independent variables	(1) WTEMIG	(2) WTEMIG	(3) BLKMIG	(4) BLKMIG
Constant	13.11 (1.40)	93.36 (4.24)	−61.74 (4.93)	70.04 (2.17)
MEDINC	−0.00014 (0.10)	0.00162 (1.07)	0.01263 (6.75)	0.00638 (2.87)
UNEMP	−1.866 (2.44)	−2.906 (4.26)	−0.4669 (0.45)	−1.891 (1.88)
Warmth		0.01030 (4.44)		0.00510 (1.50)
Cold		0.00686 (4.27)		0.00968 (4.10)
ANTMVR		−0.99890 (4.86)		−1.281 (4.25)
ANNWND		−2.967 (4.49)		−0.4171 (0.43)
ANNHUM		−0.7164 (4.74)		−0.9556 (4.30)
R^2	0.043	0.347	0.259	0.392
SE	12.67	10.67	16.99	15.68

3. EMPIRICAL RESULTS

In Table 2 net migration results, not disaggregated by age, are presented. Comparing Eqs. (1) and (3) it appears that whites are more concerned about employment and are insignificantly affected by income differentials, while nonwhites are very significantly drawn to areas with high incomes and insignificantly deterred by differentially high unemployment rates. This finding, questioned below, has been frequently observed in the migration literature (see Greenwood [7], Lansing and Mueller [10], and Persky and Kain [14]).

However, including climate controls makes clear that the races are not as differently motivated as previously thought.[2] Comparing the ordinary to the climate-controlled equations in Table 2 reveals a positive and larger effect of income differentials for whites (though this effect remains insignificant) and a 50% reduction in the importance of weather-controlled income differentials for nonwhites. Similarly, unemployment exerts a much larger effect for both whites and nonwhites than is suggested by Eqs. (1) and (3). The biases indicated by these results are clear—whites with higher average incomes than nonwhites are moving to areas with nice climates but differentially higher unemployment rates and lower incomes. Thus, in Eq. (1), the coefficient on unemployment (and income) is biased downward by the positive correlation between unemployment and nice weather. Nonwhites, with much lower incomes than whites on average, are moving to capture differentially higher incomes with climatic amenity demands being of less importance for this lower income group. Of particular note in comparing Eqs. (3) and (4) is the finding that the deterring effect on nonwhite migration of high unemployment is much larger and more significant when climate is held constant.

The relative white–nonwhite importance of climate in migration may be seen in the coefficients of determination of Table 2. The traditional economic variables explain very little of the white migration by themselves; inclusion of the climate amenity variables results in a large increase in R^2. For the lower income nonwhites the economic variables are more important, with climate adding much less to the explanation of observed migration.

Summarizing the effects of the various climate controls, whites are moving toward both warmth and cold and away from annual temperature variance, wind, and humidity. Nonwhites are moving toward cold (for which they receive income compensation—see Linneman and

[2] On a slightly different data set, the specification of the climate effect used in Eqs. (2) and (4) in Table 2 was preferred to alternatives involving quadratic terms and different combinations of weather variables (see Graves [5]).

Graves [11], Izraeli [9] and away from annual temperature variance and humidity.

Life Cycle Findings

Tables 3, 4, 5, and 6 disaggregate the equations of Table 2 by age, with pronounced life-cycle effects becoming apparent. Tables 3 and 4 are only included to note that the life-cycle effects are sufficiently strong (see for example the coefficients on income for white migrants aged 25 to 30 and 30 to 35 and those over 60 in Table 3) to yield significant coefficients on income and unemployment for many age cohorts even in

TABLE 3

White Net Migration by Age for Eq. (1), Table 2. *t*-Values in Parentheses. 137 Observations

Dependent variable	Constant	MEDINC	UNEMP	R^2	SE
WTEMIG 20–24	88.71 (3.66)	−0.00739 (2.04)	−7.299 (3.68)	0.109	32.85
WTEMIG 25–29	−9.418 (0.49)	0.00803 (2.77)	−4.827 (3.04)	0.123	26.31
WTEMIG 30–34	−39.75 (2.34)	0.00858 (3.38)	−0.5914 (0.43)	0.082	23.02
WTEMIG 35–39	−7.865 (0.62)	0.00243 (1.28)	−0.6974 (0.67)	0.017	17.22
WTEMIG 40–44	1.673 (0.16)	0.00090 (0.59)	−0.8833 (1.06)	0.012	13.76
WTEMIG 45–49	3.282 (0.37)	0.00063 (0.48)	−1.024 (1.41)	0.017	12.06
WTEMIG 50–54	8.287 (1.07)	−0.00033 (0.29)	−0.9217 (1.45)	0.016	10.51
WTEMIG 55–59	13.42 (1.81)	−0.00147 (1.32)	−0.7136 (1.17)	0.021	10.08
WTEMIG 60–64	32.36 (3.28)	−0.00489 (3.31)	−0.5292 (0.65)	0.076	13.39
WTEMIG 65–69	53.93 (4.00)	−0.00883 (4.38)	−0.2798 (0.25)	0.126	18.29
WTEMIG 70–74	48.60 (4.16)	−0.00783 (4.49)	−0.2722 (0.28)	0.131	15.83
WTEMIG 75–up	25.22 (3.09)	−0.00333 (2.73)	−0.3813 (0.57)	0.053	11.08

TABLE 4

Nonwhite Net Migration by Age for Eq. (3), Table 2. t-Values in Parentheses. 137 Observations

Dependent variable	Constant	MEDINC	UNEMP	R^2	SE
BLKMIG 20–24	−108.9 (1.15)	0.02877 (2.03)	−2.937 (0.38)	0.032	128.5
BLKMIG 25–29	−207.5 (5.62)	0.04346 (7.88)	−3.178 (1.05)	0.328	50.80
BLKMIG 30–34	−139.6 (7.41)	0.02539 (9.02)	0.3195 (0.21)	0.379	25.54
BLKMIG 35–39	−78.36 (5.84)	0.01384 (6.90)	0.7109 (0.65)	0.262	18.21
BLKMIG 40–44	−57.23 (5.63)	0.00938 (6.17)	1.375 (1.65)	0.226	13.79
BLKMIG 45–49	−43.21 (4.97)	0.00763 (5.88)	0.6896 (0.97)	0.206	11.78
BLKMIG 50–54	−41.65 (3.82)	0.00649 (3.98)	1.867 (2.09)	0.123	14.78
BLKMIG 55–59	−38.22 (3.79)	0.00720 (4.78)	0.3929 (0.48)	0.146	13.68
BLKMIG 60–64	−29.47 (2.13)	0.00541 (2.62)	0.8389 (0.74)	0.050	18.74
BLKMIG 65–69	−31.20 (1.58)	0.00354 (1.20)	3.841 2.38)	0.047	26.73
BLKMIG 70–74	−20.68 (0.62)	0.00448 (0.91)	0.4850 (0.18)	0.006	44.89
BLKMIG 75-up	−54.57 (2.37)	0.01149 (3.35)	−2.469 (0.10)	0.078	31.17

the presence of the substantial bias due to omitted climate variables.

Tables 5 and 6 are of principal interest and display both plausible and surprising findings.

A. Life cycle white migration. Higher income areas importantly attract whites in the 25 to 35 age cohorts. The effects of income drop off sharply for those 35 and over and, indeed, become significantly negative for retirees.[3] This latter negative effect of income on migration is no

[3] Throughout this study migration patterns of those 75 and over were quite different from the patterns of those between 65 and 75. This likely reflects the fact that the very old are moving in with their offspring. Also, the results for those 60 to 65 suggest that many in this cohort are early retirees.

TABLE 5

White Net Migration by Age for Eq. (2), Table 2. t-Values in Parentheses. 137 Observations

Dependent variables	Constant	MEDINC	UNEMP	Warmth	Cold	ANTMVR	ANNWND	ANNHUM	R^2	SE
WTEMIG 20–24	231.0	−0.00751	−8.479	0.00420	0.00502	−1.028	−2.473	−1.322	0.183	32.05
	(3.49)	(1.65)	(4.13)	(0.60)	(1.04)	(1.67)	(1.25)	(2.91)		
WTEMIG 25–29	70.88	0.01555	−5.850	0.01283	0.00475	−1.025	−4.724	−0.8867	0.352	23.04
	(1.49)	(4.76)	(3.97)	(2.56)	(1.37)	(2.31)	(3.80)	(2.71)		
WTEMIG 30–34	46.63	0.01351	−1.882	0.01522	0.00828	−1.263	−4.821	−0.7773	0.299	20.51
	(1.10)	(4.64)	(1.43)	(3.41)	(2.68)	(3.20)	(3.80)	(2.67)		
WTEMIG 35–39	99.77	0.00409	−1.985	0.01195	0.00845	−1.196	−4.009	−0.9416	0.274	15.09
	(3.21)	(1.91)	(2.06)	(3.64)	(3.72)	(4.12)	(4.29)	(4.40)		
WTEMIG 40–44	85.37	0.00270	−1.957	0.01109	0.00737	−1.019	−3.399	−0.7457	0.309	11.72
	(3.53)	(1.62)	(2.61)	(4.35)	(4.17)	(4.52)	(4.68)	(4.48)		
WTEMIG 45–49	65.98	0.00260	−1.902	0.01020	0.00634	−0.8484	−2.979	−0.5660	0.304	10.34
	(3.09)	(1.77)	(2.87)	(4.54)	(4.07)	(4.26)	(4.65)	(3.86)		
WTEMIG 50–54	68.00	0.00126	−1.753	0.01002	0.00627	−0.8244	−2.462	−0.5778	0.339	8.78
	(3.76)	(1.01	(3.12)	(5.25)	(4.74)	(4.88)	(4.53)	(4.64)		
WTEMIG 55–59	70.39	0.00014	−1.565	0.01143	0.00694	−0.8795	−2.190	−0.6023	0.399	8.05
	(4.24)	(0.12)	(3.04)	(6.54)	(5.73)	(5.68)	(4.40)	(5.28)		
WTEMIG 60–64	107.4	−0.00271	−1.695	0.01633	0.00976	−1.243	−2.478	−0.8472	0.467	10.37
	(5.02)	(1.84)	(2.56)	(7.25)	(6.25)	(6.23)	(3.86)	(5.76)		
WTEMIG 65–69	159.5	−0.00567	−1.953	0.02339	0.01391	−1.804	−3.217	−1.209	0.535	13.59
	(5.69)	(2.94)	(2.25)	(7.92)	(6.79)	(6.90)	(3.82)	(6.27)		
WTEMIG 70–74	137.9	−0.00471	−1.630	0.01977	0.01126	−1.490	−2.531	−1.100	0.558	11.51
	(5.81)	(2.88)	(2.21)	(7.90)	(6.49)	(6.73)	(3.55)	(6.74)		
WTEMIG 75–up	75.86	−0.00362	−0.9770	0.01098	0.00494	−0.7101	−1.194	−0.8169	0.561	7.69
	(4.78)	(0.33)	(1.98)	(6.56)	(4.27)	(4.80)	(2.51)	(7.49)		

TABLE 6

Nonwhite (Primarily Black) Net Migration by Age for Eq. (4), Table 2. *t*-Values in Parentheses. 137 Observations

Dependent variables	Constant	MEDINC	UNEMP	Warmth	Cold	ANTMVR	ANNWND	ANNHUM	R^2	SE
BLKMIG 20–25	915.6	−0.02040	−12.88	0.00615	0.05625	−8.457	−1.915	−6.968	0.196	119.4
	(3.72)	(1.20)	(1.69)	(0.24)	(3.13)	(3.68)	(0.26)	(4.12)		
BLKMIG 25–29	164.6	0.02657	−7.778	0.02803	0.03479	−4.448	−0.0570	−2.936	0.477	45.02
	(1.77)	(4.16)	(2.70)	(2.86)	(5.13)	(5.13)	(0.02)	(4.60)		
BLKMIG 30–34	−58.73	0.02149	−0.9359	0.00643	0.00864	−1.210	−0.0227	−0.4314	0.417	25.22
	(1.13)	(6.00)	(0.58)	(1.17)	(2.28)	2.49)	(0.01)	(1.21)		
BLKMIG 35–39	−17.16	0.01215	0.1311	0.00107	0.00293	−0.5054	−0.4524	−0.4722	0.281	18.32
	(0.45)	(4.67)	(0.11)	(0.27)	(1.06)	(1.43)	(0.40)	(1.82)		
BLKMIG 40–44	−11.74	0.00838	0.9388	0.00007	0.00166	−0.3660	−0.4581	−0.3062	0.244	13.89
	(0.41)	(4.25)	(1.06)	(0.02)	(0.79)	(1.37)	(0.53)	(1.55)		
BLKMIG 45–49	−31.54	0.00701	0.3122	0.00204	0.00233	−0.3337	−0.7171	−0.3515	0.235	11.78
	(0.13)	(4.19)	(0.41)	(0.80)	(1.31)	(1.47)	(0.98)	(2.10)		
BLKMIG 50–54	26.50	0.00256	1.159	0.00458	0.00640	−0.6192	−0.8178	−0.5320	0.207	14.33
	(0.90)	(1.26)	(1.26)	(1.47)	(2.96)	(2.25)	(0.92)	(2.62)		
BLKMIG 55–59	23.98	0.00453	−0.3027	0.00246	0.00470	−0.5766	−1.207	−0.3599	0.197	13.52
	(0.86)	(2.36)	(0.35)	(0.84)	(2.31)	(2.22)	(1.44)	(1.88)		
BLKMIG 60–64	1.789	0.00194	0.4266	0.00706	0.00674	−0.3664	−1.185	−0.2710	0.120	18.39
	(0.05)	(0.74)	(0.36)	(1.77)	(2.43)	(1.04)	(1.04)	(1.04)		
BLKMIG 65–69	97.22	−0.00160	2.772	−0.00197	0.00477	−0.8189	−1.124	−0.8609	0.099	26.49
	(1.78)	(0.43)	(1.64)	(0.34)	(1.19)	(1.61)	(0.69)	(2.29)		
BLKMIG 70–74	−61.12	−0.00113	0.9064	0.00904	0.00654	0.2892	−1.285	−0.0153	0.061	44.47
	(0.67)	(0.18)	(0.32)	(0.94)	(0.98)	(0.34)	(0.47)	(0.02)		
BLKMIG 75–up	48.99	0.00557	−1.631	0.00340	0.00858	−1.283	0.5923	−0.5454	0.129	30.87
	(0.77)	(1.27)	(0.83)	(0.51)	(1.84)	(2.16)	(0.31)	(1.25)		

doubt due to the positive correlation between income and price levels across SMSAs. Hence, with fixed nominal incomes from social security, private pension, and annuity plans the old can obtain larger real incomes in SMSAs with lower median incomes. These negative effects of income (acting through prices) for older migrants in large part offset the strong positive effects of income for the young, thus accounting for the weak and insignificant overall effect of income on white migration when this migration is not disaggregated by age (Eq. (2), Table 2).

The effect of differential unemployment rates on white migration is as expected. That is, high unemployment rates are a very strong deterrent to migration for the younger migrants (aged 20 to 30) while the effect for older groups is much smaller though in all cases significantly different from zero.[4]

The weather effects by age for white migrants are broadly as expected, with one small surprise. A large jump in the importance of warmth, humidity, and annual temperature variance is seen for those of retirement age—these results accord closely with *a priori* expectations. However, the jump at retirement in the positive effect of cold was unanticipated. The only immediate explanation of this finding is that many older people, already in warm cities, move to join their children in cities which are colder on average. This flow may in part be helping to offset the larger net effect of warmth in drawing old people.[5]

Of note in Table 5 is the fact that the variables included explain relatively more of the variance of net migration between the SMSAs for old people than for young people. This is to be contrasted with the case for nonwhite net migration (Table 6) in which much higher R^2 are obtained for the young.[6]

B. Life cycle nonwhite migration. The white–nonwhite life cycle patterns are frequently similar (e.g., the income coefficient in Tables 5 and 6). However, the many unexpected positive signs on unemployment require some discussion. First, it should be noted that the effect of unemployment on nonwhite net migration is of the expected sign and very

[4] The small jump in the negative effect of unemployment at retirement may reflect attempts on the part of old people to begin a new job.

[5] The annual temperature variance coefficient combined with the findings for Warmth and Cold suggests that perhaps people are different in their tastes—some liking cold, others liking warmth, but few wanting both in the same place during the year.

[6] The youngest age group for both races behaves rather oddly. This probably reflects the joint effect of young adults moving with their parents, as well as to obtain schooling, in addition to the ordinary household behavior presumed to dominate older age groups. Not too much should be made of the differences in the coefficients for this age group.

significant for the 20 to 25 and 25 to 30 age groups. Indeed, the effect is larger than for whites in these age groups, a result strongly at odds with the non-age-disaggregated results of Table 2 (and the findings of the migration literature already cited). But, for the bulk of the age groups, unemployment is insignificant and positive in its effects on net nonwhite migration.

One possible explanation for this latter finding is forthcoming in the presence of discrimination. If one assumes that (a) nonwhites are more likely to migrate to a city with more nonwhites already present and (b) a city with more nonwhites will have higher unemployment rates because of discrimination, then two conflicting migration motivations will be present.[7] The higher unemployment rates will discourage nonwhite inmigration (which dominates for the young) while the larger black population will encourage nonwhite inmigration (which dominates for the older age groups).

In general, the various weather variables mattered less in nonwhite migration than in white migration, except for the youngest age groups in which all weather characteristics except wind speed have a larger effect on nonwhte than on white migration.

4. SUMMARY AND IMPLICATIONS

The findings of the previous section suggest that earlier analyses of inter-SMSA migration which have not disaggregated by age lead to inappropriate conclusions. Reiterating, unemployment is important in nonwhite migration (indeed more important than in white migration for young age groups) but the negative effects in one age group are offset by positive effects in others. Similar results hold for the income effect on white migration—the very significant effects for groups in different stages of the life cycle offset one another in an aggregate analysis. The reason for these offsetting effects is that other Tiebout-like aspects of a city (climate being of major importance) are correlated with income and unemployment, since the latter in large part serve as compensatory differentials due to variation in the former. Hence, migrants are purchasing a bundle of location-specific goods and the relative importance of economic opportunity and climatic amenities within that bundle varies by age (and by income, interpreting the race differences as due to that group's lower average income).

Further, the bias attached to the income and unemployment coefficients for all age groups due to omission of climate variables has been ignored in earlier work. As mentioned at the outset, the only explanation in the

[7] Psychic and informational costs would presumably be lower for nonwhite migrants for cities having larger nonwhite populations.

literature for the lack of significance and occasional wrong signs on income and unemployment relate to using end-of-period variables. In light of the large biases uncovered here using beginning-of-period variable definitions, this source of bias is likely to be small relative to that due to omitted variables.

The results presented here have important policy implications. In order for an urban area to project future demands for public services relative to the future tax base, the net inmigration of various age groups must be projected. The analysis presented here suggests that where a city stands in the spectrum of SMSA climate offerings will importantly affect its future growth. Additionally, the changing demographic characteristics of the population (e.g., higher proportions of older people) will interact with the migration-climate-economic opportunity process as suggested by the life cycle findings.

ACKNOWLEDGMENTS

Financial support by NSF Grant No. GI 32989 A2 is gratefully acknowledged. The author wishes to thank G. Becker, J. Gardner, G. Ghez, M. Reid, G. Tolley, C. Upton, and an anonymous referee for helpful comments on an earlier draft. Special thanks are due to P. Linneman for numerous long discussions and to R. Millstein and G. Bowles for making available the raw data from which the net migration rates by SMSA were calculated and for computational assistance, respectively. I share responsibility for any remaining errors with none of those acknowledged above.

REFERENCES

1. G. S. Becker, "Human Capital," Columbia University Press (NBER), New York, 1964.
2. G. K. Bowles, C. L. Beale, and E. S. Lee, "Net Migration of the Population, 1960-70 by Age, Sex, and Color," University of Georgia Printing Department, Georgia (1975).
3. R. J. Cebula and R. K. Vedder, A note on migration, economic opportunity, and the quality of life, *Journal of Regional Science* **13**, 205–211 (1973).
4. L. E. Gallaway, Age and labor mobility patterns, *Southern Economic Journal* **36**, 171–180 (1969).
5. P. E. Graves, A reexamination of migration, economic opportunity, and the quality of life, *Journal of Regional Science,* **16**, (1976).
6. P. E. Graves, "Migration and Climate," Mimeo (1976b).
7. M. J. Greenwood, Research on internal migration in the United States: A survey, *Journal of Economic Literature,* **13**, 397–433 (1975).
8. M. J. Greenwood and D. Sweetland, The determinants of migration between standard metropolitan statistical areas, *Demography,* **9**, 665–681 (1972).
9. O. Izraeli, "Differentials in Nominal Incomes and Prices between Cities," Ph.D. dissertation, University of Chicago, Department of Economics.
10. J. B. Lansing and E. Mueller, "The Geographic Mobility of Labor," Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor (1967).

11. P. D. Linneman and P. E. Graves, "Compensating Differentials and the Demand for Weather," Mimeo (1976).
12. Ben-chieh Liu, Differential net migration rates and the quality of life," *Review of Economics and Statistics,* **52**, 329–337 (1975).
13. Ben-chieh Liu, "Variations in Environmental Quality Indicators in Medium Metropolitan Areas," paper presented at the Western Economic Association meetings, San Francisco (June 1976).
14. J. J. Persky and J. F. Kain, Migration, employment, and race in the deep south, *Southern Economic Journal,* **36**, 268–276 (1970).
15. L. A. Sjaastad, The costs and returns of human migration, *Journal of Political Economy,* **70**, 80–93 (1962).
16. C. M. Tiebout, A pure theory of local expenditures, *Journal of Political Economy,* **64**, 416–424 (1956).
17. U. S. Bureau of the Census, "U. S. Census of Population: 1960," Vol. I, "Characteristics of the Population," Part 1, United States Summary, U. S. Government Printing Office, Washington (1964).
18. U. S. Department of Commerce, Environmental Data Service, "Climatological Data, National Summary," National Oceanic and Atmospheric Administration, Ashevill, N. C.
19. R. F. Wertheimer, III, "The Monetary Rewards of Migration Within the U. S." The Urban Institute, Washington, D. C. (1970).