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MIGRATION AND CLIMATE*

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1. INTRODUCTION

From the time of Sjaastad's [13] now classic article until the present, migration has been taken to represent an investment in human capital over space. If the benefits of movement exceed the costs, both appropriately discounted, an investment in migration will increase lifetime utility in essentially the same way as will an investment in education. While adopting this very generally acceptable theoretical model, the literature on migration has gradually developed along two quite distinct lines.

Stemming from sweeping world migrations, associated fundamentally with disequilibrium, the dominant branch of the economics literature on migration has stressed income and employment opportunity differentials. For example, the rural to urban migration observed over long historical periods in most countries is due to higher amenity-corrected levels of expected satisfaction in urban areas.[1] Similarly, discoveries of gold, former slaves being freed to seek Northern opportunities, natural disasters such as dust bowls and so on have led to major and persistent spatial utility differentials with resultant migration.

A much smaller literature of recent vintage has developed which is associated fundamentally with equilibrium processes. This work, represented by Graves and Linneman [6] and Polachek and Horvath [11], has its roots in urban economic theory (see, e.g., Alonso [1]). In this view of migration, market rents and wages are expected to adjust so as to leave utility constant over space. Hence, within a city rent differentials will emerge to remove any advantages associated with access to the center, parks and the like, while across cities wages will be lower in desirable areas by an amount equivalent in utility to the amenities obtained by locating there. Migration, viewed in this way, takes place as a result of changes in demand for location-fixed amenities. This process is described more fully in Section 2 below where the discussion centers on the importance of climate.

While both approaches to migration will continue to be relevant, the equilib-

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[1]See Clawson and Graves [4] and Price [12] for reviews of the rural to urban migration literature.

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rium, amenity-oriented approach is likely to be of increasing relative importance in the years to come. Beale's [2] finding, using post-1970 census data, that nonmetropolitan counties are, for the first time in this century, growing more rapidly than metropolitan counties provides casual empirical support for this conjecture. Section 3 presents stronger evidence that income and unemployment differentials no longer systematically represent utility differentials in the U.S. At the theoretical level, improvements in information transfer combined with high mobility rates reduce the likelihood of such persistent spatial utility differentials in the future.

2. MIGRATION AND CLIMATE: TWO MODELS

One may envision each city as supplying a particular climate bundle. Some cities will have more attractive bundles than others; hence, for spatial indifference to obtain, less of other goods must be consumed in the attractive cities than elsewhere. That is, one city may supply good weather with lower expected incomes while another supplies bad weather with compensatingly higher expected incomes. This idea of compensating differentials goes back at least to Adam Smith and, more recently, has been applied to local public goods by Tiebout [14]. Formally, the individual is assumed to maximize utility subject to an income constraint which, in equilibrium, incorporates the compensating differentials

$$\text{Max } U = U(X, C) \qquad (1)$$
$$\text{Subject to } I = X + P_C C$$

where X is the vector of numeraire tradable goods, C is a vector of climate characteristics (temperature, humidity, etc.) and P_C is the price of climate (the compensating differentials).[2] The formulation of (1) assumes without loss of generality that the climate characteristics can be smoothly varied, both individually and collectively.

The two approaches to migration introduced in Section 1 are readily interpreted in terms of (1). The persistent disequilibrium migration approach, represented by the analyses of past rural to urban migration, argues that the compensation is not complete, with higher nominal incomes reflecting higher real incomes. Hence, income differentials are introduced into migration regressions with the theoretical anticipation, ceteris paribus, that a high income area will have lower gross outmigration flows and higher gross inmigration flows as people move to arbitrage away the persistent utility differentials.

Under the second approach, at any point in time there may be no incentive to migrate since full compensation takes place with utility being the same everywhere for identical individuals.[3] As with ordinary goods, changed demands for climate

[2]The compensating differentials may take many forms in general: higher rents or lower incomes in attractive areas, higher pollution levels (e.g., Los Angeles) as people move into the area and so on. The compensation received for climate may be established through hedonic regressions on, for example, income differentials (see Izraeli [9], Linneman and Graves [10]).

[3]To further clarify how the two approaches differ rewrite the budget constraint as $N = R - P_C C - X$, where N stands for nominal income and R is real income (marginal productivity) and the other symbols are as in the text. One may write R and P_C as random variables, $R = \bar{R} + u_R$ and

result largely from changed relative prices and changed incomes (in all locations), with age and race being potentially important shifters.[4] For example, a rise in income will result in an increased demand for leisure activity on the part of an individual. Since leisure activity will often involve outdoor recreation (golf, tennis, skiing, etc.), one would be led to expect revised demands for those climates most amenable to the production of such outdoor activities. It does not matter substantively whether one thinks of the process in this Beckerian way or merely puts climate directly in the utility function, as in (1), with some climate characteristics being inferior, normal or superior, although the household production approach is perhaps more intuitively satisfying in this context.

The empirical implications of the two approaches to migration are quite different.. Under the second approach, unlike the first, one would not expect income differentials to lead to migration since those differentials reflect compensation for climate differences, i.e., equilibrium consumption choices, and not real utility differences available for identical individuals. This theoretical point accounts for the difficulty experienced by some authors using recent data in finding significant income and unemployment coefficients of the correct sign (see Greenwood [7]). It is not even a priori clear that there is a correct sign, e.g., on median group-specific income under the second approach, since there is no compelling reason for expecting a positive correlation between nominal income and real income.[5] These issues are pursued in greater detail in the empirical section which follows.

3. EMPIRICAL RESULTS

Based on the considerations of the previous section, one may infer that generally rising incomes over the 1965 to 1970 period may have led to changed demands for particular characteristics of climate. If, for example, high humidity is an inferior good, then a city supplying high humidity will on that account alone have a larger flow of outmigrants and a smaller flow of inmigrants.

Gross migration flows are preferable as a dependent variable for two reasons. First, the gross flow data better fit the individual decision-making model of the previous section than do the more readily accessible net migration data. Further,

$P_C = \overline{P}_C + u_C$, where the error terms are distributed perhaps normally with mean zero. If the variance is large (suggesting the importance of the persistent utility differentials), there is an incentive to search, and the first approach to migration becomes the dominant influence. If the variance is near zero, the second approach to migration is indicated, since real income is everywhere the same. Similar comments apply to P_C in general, since, for example, the price of clean air in Los Angeles may not be the same as in other cities.

[4]Becker [3] hypothesized (and Wertheimer [16] empirically verified) that age should be negatively related to migration for discounting reasons, even if psychological ties (to friends, institutions) were not more important for older individuals.

[5]Illustrating, Detroit has a quite high median income relative to other larger cities, holding median age and education constant (see Linneman and Graves [10]). Yet if Detroit offers inferior (in the economic sense) climate amenities during a period of rising incomes, the higher than average nominal compensation may in fact correspond to lower than average real utility in that city. Hence, one would observe migration away from the high nominal income area on balance.

TABLE 1: Summary Statistics: Gross Migration Flows, Unemployment Rates, and Median Income by Age, Race, and Sex[a]

Age Group	Inmigration								Outmigration							
	White Males		White Females		Nonwhite Males		Nonwhite Females		White Males		White Females		Nonwhite Males		Nonwhite Females	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
15–19	.25	.13	.24	.12	.16	.13	.16	.13	.26	.08	.23	.07	.14	.07	.10	.05
20–24	.51	.23	.51	.21	.25	.16	.25	.16	.48	.11	.40	.10	.22	.11	.15	.09
25–34	.32	.14	.28	.13	.13	.08	.12	.07	.28	.11	.26	.09	.11	.07	.09	.05
35–44	.16	.09	.13	.07	.07	.06	.06	.04	.15	.06	.13	.05	.06	.04	.05	.03
45–54	.11	.07	.10	.06	.04	.03	.05	.04	.11	.05	.09	.04	.04	.02	.03	.02
55–64	.08	.07	.08	.07	.03	.03	.04	.03	.08	.03	.09	.03	.03	.02	.03	.02
65-up	.08	.09	.10	.08	.04	.02	.05	.04	.09	.03	.09	.03	.04	.03	.04	.02
	SMSA Unemployment Rates								SMSA Median Incomes							
15–19	4.6	1.3	2.5	.72	7.3	2.1	4.9	1.6	743	55	748	64	771	115	698	92
20–24	5.4	2.3	2.4	.66	11.4	5.4	6.3	1.9	3010	446	1968	312	2132	340	1134	344
25–34	3.2	1.1	1.6	.49	7.8	3.7	4.4	1.3	5287	451	2097	317	3379	592	1577	443
35–44	2.9	.87	1.7	.58	7.3	3.3	4.0	1.3	6014	449	2296	320	3732	685	1639	484
45–54	3.4	.88	1.7	.52	7.0	2.4	3.2	1.2	5688	491	2479	352	3497	666	1427	407
55–64	3.8	1.0	1.3	.40	6.4	3.0	2.3	.78	5003	571	1910	343	3020	660	1074	271
65-up	1.6	.59	.4	.15	2.8	1.0	.7	.35	2137	214	858	146	1354	341	694	178

[a]The nonwhite male and female unemployment and income data are based on the 42 observation subsample. The remaining data are for the full 49 SMSA sample for which all information was available.

as has been pointed out by Greenwood [7, p. 408], the use of net migration amplifies the relation between migration and income differentials.[6]

The data employed to investigate the migration-climate-economic opportunity relationship over the life cycle are described, with summary statistics, in Tables 1 and 2. There were 49 Standard Metropolitan Statistical Areas (SMSA's) for which all data were available for the white gross migration analysis and 42 for the nonwhite analysis. The age-race-sex specific migration data in Table 1 are for the 1965–1970 period obtained from census information contained in *Mobility for Metropolitan Areas*. The income and unemployment data, also in Table 1, for these same demographic groups are as of 1960.[7] The weather variables, described

[6]Letting IM and OM be gross inmigration and outmigration flows, then migration as it relates to income differentials would be estimated as $IM = a_0 + a_1 Y$, $OM = b_0 + b_1 Y$, and $NETMIG = IM - OM = (a_0 - b_0) + (a_1 - b_1)Y$. Since one would expect (under the first approach) that $a_1 > 0$ and $b_1 < 0$, then $(a_1 - b_1)$ overstates the behavioral relation between migration and (real) income differentials.

[7]Greenwood and Sweetland [8] show that using end-of-period income definitions results in downward bias on the income differential coefficient (migration over the period affecting income as well as conversely). To avoid this bias, to which Greenwood [7] attributes the frequent finding of a lack of significance of the income coefficient, 1960 data were used for the independent variables. The present work implies far more compelling reasons for expecting income differentials not to matter, since they represent compensating, not real, differences.

TABLE 2: Summary Statistics and Descriptions for Climate Variables

Variable	Mean	S.D.	Description
ANTMVR	58.0	11.4	Annual Temperature Variance (in F°), defined as the difference between the average July maximum temperature and the average January minimum temperature.
ANNWND	9.3	1.4	Annual Wind Velocity (in m.p.h.), a simple average of the normal July and January wind velocities.
ANNHUM	60.9	7.1	Annual Average Humidity, the average of 1:00 P.M. and 7:00 P.M. average relative humidities for July and January.
WARMTH	767.6	543	Warmth, defined as average annual cooling degree days for recent years for which such data are available.[a]
COLD	4511.0	2015	Cold, defined as the normal annual amount of heating degree days for the period 1931–1960.[a]

[a]The base for both degree day variables is 65°F. Thus, a day in which the average temperature is 50° would receive 15 heating degree days and zero cooling degree days, while a day having an average temperature of 80° would be recorded as having zero heating degree days and 15 cooling degree days. Each of the annual variables is formed by summing the respective degree days over the entire year. If the ideal data were available, for present purposes, the base for both measures would be 68–72° or so—whatever the perfect temperature is from which divergences could be clearly interpreted as cold or warm. Such ideal measures would, however, correlate highly with those employed here.

Source: U.S. Dept. of Commerce [15].

in Table 2, are 1931–1960 means or normals with the exception of cooling degree days which was averaged for several recent years (being unavailable for the earlier period). This treatment ensures that the weather data attributed to each SMSA are in fact typical for that SMSA.

Of note among the summary statistics in Table 1 is that nonwhite gross migration rates of flow are approximately half as large as corresponding white rates of flow regardless of the age-sex class. This observation runs counter to the finding that nonwhites have higher net migration rates (see Graves [5]). However, as Graves and Linneman [6] have argued, the reduced opportunity set of potential locations facing nonwhites in the presence of discrimination would reduce their probability of moving in the face of an exogenous shift (e.g., an income increase). The gross flow analysis is consistent with this expectation, while net migration analyses obscure the discrimination effect on mobility since nonwhite migration is more one-way. Much of the remaining information in Table 1 is not surprising, with nonwhite mean unemployment rates higher and incomes lower in all groups.[8]

Regression results are only reported for white males, with sex-race differences commented on at the close of this section.[9] Under the first (disequilibrium)

[8]The exception, the 15–19 male group, is readily understandable in terms of hours worked, dead-end jobs, and so on.

[9]The regression results for other groups are available upon request.

TABLE 3: White Male Gross In- and Outmigration as OLS Functions of Income[a] and Unemployment Differentials, by Age (*t*-statistics in parentheses)

Demographic Group	Constant	Income	Unemployment	R^2	F-statistic
Inmigration					
15–19	.1647	+.0110	−.0012	.002	.045
	(0.53)	(0.29)	(0.07)		
20–24	1.1358	−.0147	.0330	.275	8.74
	(5.76)	(2.09)	(2.44)		
25–34	.5557	.0014	.0482	.161	4.40
	(2.50)	(0.34)	(2.87)		
35–44	.3489	−.0021	.0233	.062	1.53
	(2.01)	(0.76)	(1.66)		
45–54	.2911	−.0033	+.0034	.060	1.45
	(2.37)	(1.65)	(0.31)		
55–64	.3674	−.0067	+.0126	.351	12.46
	(4.62)	(4.67)	(1.59)		
65-up	.3932	−.0136	.0149	.130	3.44
	(3.19)	(2.31)	(0.70)		
Outmigration					
15–19	.1461	.0012	+.0218	.124	3.27
	(0.83)	(0.06)	(2.38)		
20–24	.3341	+.0040	+.0046	.049	1.18
	(3.06)	(1.03)	(0.61)		
25–34	.8438	−.0077	.0474	.367	13.35
	(5.43)	(2.63)	(4.03)		
35–44	.2829	−.0007	−.0310	.191	5.43
	(2.43)	(0.37)	(3.29)		
45–54	.1408	.0003	−.0039	.006	.14
	(1.59)	(0.21)	(0.49)		
55–64	.1031	.0007	−.0034	.025	.60
	(2.21)	(0.78)	(0.73)		
65-up	.0876	+.0001	+.0012	.001	.02
	(1.97)	(0.51)	(0.15)		

[a]In hundreds of dollar units.

approach to migration, one would expect inmigration to be positively related to the receiving city's income and negatively related to unemployment rates. Similarly, outmigration should, on this interpretation, be negatively related to local income levels and positively related to unemployment rates. Consider first income and unemployment as the only independent variables. The regression results of Table 3 run largely counter to these expectations. In fact, for inmigration all significant income coefficients are negative and the unemployment coefficients exhibit a sprinkling of unanticipated signs, while for outmigration the only significant coefficient on income (for the 25–34 age group) has the correct sign, but the two significant unemployment coefficients are negative, which indicates relatively less migration out of high unemployment areas. Although a plausible life-cycle pattern appears evident, the large number of unanticipated signs and low coefficients of determination even in prime earning age classes suggests that the first approach to migration lacks explanatory power.

The findings of Table 3 do not argue for irrational behavior but rather that high unemployment, low income areas are attractive for other reasons. The hypothesis tested in Table 4 is that climate ranks importantly among these other reasons. The heavy net inmigration to amenity rich areas may further contribute to their keeping nominal income low and unemployment high. These interpretations, supporting the more recent equilibrium-amenity approach to migration, are bolstered by the findings of Table 4 which include climate variables as independent regressors along with income and unemployment differentials.

If we compare Tables 3 and 4, two observations appear particularly relevant with respect to the issue of which approach to migration is appropriate. First, the explanatory power added by the climate variables is impressive in virtually all age groups. Climate quite clearly does matter in the migration decision, suggesting that certain weather amenities are normal and others are inferior since real productivity has risen over the period covered by the data. Second, the income and

TABLE 4: White Male Gross In- and Outmigration as OLS Functions of Income[a], Unemployment, and Climate Variables, by Age (t-statistics in parentheses)

Demographic Group	Constant	Income	Unemploy-ment	*ANTMVR*	*ANNWND*	*ANNHUM*	*WARMTH*[b]	*COLD*[b]	R^2	F-statistic
Inmigration										
15–19	.0437	−.0113	+.0160	+.0079	+.0134	+.0005	−.0053	−.0081	.390	3.75
	(0.11)	(0.35)	(1.13)	(2.39)	(1.04)	(0.17)	(0.75)	(2.77)		
20–24	.3950	−.0104	−.0195	+.0115	+.0224	+.0044	−.0142	−.0113	.363	3.34
	(0.67)	(1.37)	(1.31)	(1.86)	(0.92)	(0.81)	(1.14)	(2.10)		
25–34	.2896	+.0035	−.0222	+.0045	+.0133	−.0024	−.0056	−.0062	.330	2.89
	(0.64)	(0.77)	(1.22)	(1.15)	(0.89)	(0.70)	(0.72)	(1.84)		
35–44	−.0178	+.0025	+.0034	+.0040	+.0118	−.0015	−.0023	−.0049	.466	5.11
	(0.66)	(1.02)	(0.26)	(1.83)	(1.44)	(0.82)	(0.51)	(2.65)		
45–54	.0782	+.0005	+.0135	+.0029	+.0078	−.0017	−.0016	−.0037	.506	6.00
	(0.38)	(0.28)	(1.33)	(1.63)	(1.25)	(1.15)	(0.44)	(2.58)		
55–64	.3358	−.0019	+.0132	−.0004	−.0028	−.0032	+.0050	−.0003	.626	9.80
	(1.95)	(1.16)	(1.64)	(0.22)	(0.52)	(2.43)	(1.63)	(0.25)		
65-up	.6322	−.0008	−.0219	−.0066	−.0084	−.0057	+.0166	+.0040	.706	14.05
	(3.34)	(0.20)	(1.26)	(3.50)	(1.36)	(3.63)	(5.08)	(2.92)		
Outmigration										
15–19	−.1058	−.0148	+.0317	+.0072	−.0078	+.0025	−.0054	−.0062	.547	7.08
	(0.50)	(0.86)	(4.28)	(4.15)	(1.16)	(1.56)	(1.47)	(4.10)		
20–24	−.2638	+.0077	+.0123	+.0049	+.0041	+.0037	+.0049	−.0032	.248	1.93
	(0.85)	(1.95)	(1.58)	(1.52)	(0.32)	(1.29)	(0.75)	(1.14)		
25–34	.5657	−.0061	−.0324	+.0061	+.0119	+.0010	−.0119	−.0066	.470	5.20
	(1.74)	(1.88)	(2.48)	(2.16)	(1.12)	(0.43)	(2.12)	(2.73)		
35–44	−.0749	+.0021	−.0113	+.0048	+.0083	+.0007	−.0055	−.0050	.549	7.14
	(0.42)	(1.31)	(1.32)	(3.33)	(1.53)	(0.53)	(1.90)	(4.11)		
45–54	−.1129	+.0023	+.0079	+.0041	+.0066	−.0001	−.0045	−.0043	.552	7.20
	(0.81)	(1.86)	(1.18)	(3.43)	(1.59)	(0.14)	(1.90)	(4.46)		
55–64	.0175	+.0020	+.0055	+.0016	+.0022	−.0010	−.0017	−.0022	.494	5.72
	(0.18)	(2.27)	(1.24)	(1.80)	(0.72)	(1.37)	(0.98)	(3.22)		
65-up	.0524	+.0036	+.0072	+.0004	+.0005	−.0009	+.0012	−.0007	.332	2.91
	(0.55)	(1.81)	(0.82)	(0.42)	(0.17)	(1.18)	(0.71)	(0.96)		

[a]In hundreds of dollar units.
[b]In hundreds of degree day units.

unemployment variables continue to have wrong signs and low significance, counter to the usual expectations. Indeed, in all cases where these variables are significant or near significant at usual confidence levels, the wrong sign is exhibited. A priori, one would have expected that, holding constant the climate amenities, expected income differentials would be more likely to reflect real, arbitragible utility differentials, but such appears not to be the case.

Let us next consider the effects of the climate variables. It is apparent that the stage of the life cycle is important, with the reactions of those retiring (or near retirement age) being different from those of prime working age groups. More surprising is the finding that in many cases comparisons of the signs of climate variables result in inconsistencies—for example, humidity appears to be an inferior good for the older inmigrants, but outmigration for similar age groups is negatively related to humidity. With respect to outmigration flow rates, temperature variance and wind velocity appear consistently inferior. Yet only for the oldest two age groups are comparable findings observed among inmigrants. These results are similar to those obtained in many studies of gross migration, and they are due to the fact that areas of high net migration tend also to have high gross flows in both directions.

An explanation of why this might occur is beyond the scope of the present paper, but one may suspect that the positive correlation between net migration and gross migration flows is due to one of three reasons. First, perceptual biases, with resulting return migration, may lead to the finding. For example, most tourists to Arizona or Florida make their visits in the winter and find the weather to be very attractive. Such recently experienced pleasant winters may lead to movement to such desert or tropical cities and only after some years will the heat, humidity, or allergies occurring in the summers result in heavy gross outmigration (though not enough to offset the high current gross inflow).

Alternatively, even over a five-year period, many individuals will have reduced real incomes in spite of a positive productivity trend for the economy as a whole. Hence, if a particular climate characteristic is normal, most individuals would move toward areas supplying greater amounts of that good, but those individuals having lower incomes over this period would comprise a counter-flow.

A final explanation relies on differences in preferences. As incomes rise some people prefer, for example, greater warmth (or demand more warmth in producing greater quantities of golf, tennis, or swimming) while others prefer more cold (or demand more cold in producing more downhill or cross-country skiing, ice skating, snowmobiling, and so on).

Race and Sex Differences

Regressions like those presented in Tables 3 and 4 for white males were run, also by age, for nonwhite males, white females and nonwhite females. While these regressions are too voluminous to report here, certain findings are noteworthy.

Many previous studies have shown that whites are more responsive to unemployment differentials than are nonwhites, while nonwhites are relatively more responsive to income differentials (see Greenwood [7] for references). Based on the number of "correct" signs, the present research suggests that nonwhites are more responsive to both measures of differential economic opportunity. However, as was true of the results presented in Tables 3 and 4, few coefficients were significant and some of those which were had unexpected signs (from the perspective of the first approach to migration). The R^2 of the nonwhite male regressions, like their white counterparts, showed marked improvement upon inclusion of the climate variables. A racial discrimination variable created by taking the ratio of nonwhite to white income in each age class appeared to add very little to the regression fit and performed unevenly in that unanticipated signs appear frequently (nonwhite movement away from areas with high ratios of nonwhite to white income, ceteris paribus).

Sex differences have not been discussed in the literature and these appear in the present work to be relatively minor, although R^2's are higher for the white female inmigration regressions than for the male counterparts (with about the same explanatory power for the outmigration regressions). Climate effects on both sexes were almost identical, with very few qualitative differences.

Wage Growth Implications

A testable implication of the equilibrium, amenity-oriented model of migration emphasized here concerns the relative growth of wages in cities having desirable as opposed to undesirable climates. With rising incomes leading to migration into cities having pleasant climates, one would expect such cities to have lower than national average wage growth. Similarly, loss of the labor force through outmigration from cities with undesirable climates should lead to higher than average wage growth.[10] The following illustrative sampling of cities ranked by manufacturing wage growth from 1960 to 1970 (in parentheses) supports these anticipations: Detroit (50 percent), Chicago (48 percent), Los Angeles (41 percent) and Phoenix (36 percent). More formal verification is provided in Equation (2), which regresses manufacturing wage growth on climate characteristics for the same 49 SMSA's used earlier. The population growth rate is included since urban economic theory indicates a positive causative relationship between changes in city size and changes in nominal wages.[11]

$$
\begin{aligned}
(2)\quad \text{MANWAGEGRO} = {} & \underset{(.10)}{-.0173} + \underset{(3.07)}{.0051}\,(\text{ANNHUM}) - \underset{(.03)}{.00003}\,(\text{COLD}) \\
& - \underset{(.23)}{.0008}\,(\text{WARMTH}) + \underset{(2.04)}{.0013}\,(\text{ANNWND}) \\
& + \underset{(.13)}{.00002}\,(\text{ANTMVR}) + \underset{(3.65)}{.3782}\,(\text{POPGRO}) \\
& (R^2 = .385,\ \text{F-stat.} = 4.37)
\end{aligned}
$$

The findings are quite consistent with the model underlying the migration

[10] A simultaneity issue having to do with firm (especially "footloose"), relative to household, time horizons, and adjustment rates could explain findings counter to the expectations described in the text. However, this sophistication would be unlikely to qualitatively affect the findings. The wage growth implications presented in the text are not intended to be definitive, rather suggestive of the validity of the approach to migration taken here.

[11] I am indebted to George Tolley for suggesting that this independent variable be included; results are qualitatively similar, but generally nonsignificant, if it is omitted.

results of Table 4. The significant coefficient on humidity supports the model formulation and empirical migration findings advanced here, and wind is also seen to be undesirable (increasing winter chill factors and blowing dust during the summer). Weak effects indicating that both warmth and cold are desirable but annual temperature variance is not are also seen, although these findings are not significant. With the exception of the effect of wind on wage growth the results of Equation (2) are as expected from the previous migration findings (and all of the findings are as expected based on the net migration results of Graves [5]). Hence, further evidence in support of the migration-climate model presented here results from the wage growth analysis.

4. SUMMARY AND CONCLUSIONS

This paper has argued that differences in income and unemployment across cities reflect not real utility differentials, as has been commonly assumed in the literature, but rather the compensation required for spatial indifference in a world with constantly changing demands for location-fixed goods, primarily climate.

An immediate consequence of this approach is that the ubiquitous unanticipated sign on income or unemployment is not in fact wrong, since there is no correct sign, these variables compensating for either good or bad local climate.

At least two issues may be raised at this point. First, the importance of expected income was denied in the empirical work. The assumption that is implicitly made here is that current group mean income is a good proxy for expected future earnings for that particular migrant group. It is possible that differential SMSA growth rates could result in this being an inappropriate assumption. Second, when the importance of climate was stressed, other important variables may have been overlooked. Existence of mountain scenery, ocean or lake recreational access and the like may indeed be important as may certain manmade, but location-fixed goods, such as symphonies, sporting events, and so on. Such issues, while important, appear to be more in the nature of refinements than fundamentally damaging.

The ultimate test of competing theories is, of course, how well they predict the future, beyond merely explaining the past. It seems likely that the strengths of the equilibrium-amenity approach will become increasingly apparent in a world with ever fewer frontiers and discoveries which can give rise to the persistent utility differentials emphasized in earlier work.

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