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Examining the Role of Economic Opportunity and Amenities in Explaining Population Redistribution

PETER R. MUESER

Department of Economics, University of Missouri-Columbia, 118 Professional Building, Columbia, Missouri 65211

AND

PHILIP E. GRAVES

Department of Economics, University of Colorado-Boulder, Campus Box 256, Boulder, Colorado 80309

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This paper develops a model of migration integrating equilibrium and disequilibrium components in which individuals and firms form rational expectations about future opportunities. Levels of migration are derived as functions of variations in factors influencing migrant labor demand ("economic opportunity") and migrant labor supply ("residential amenities"). The model is used to estimate the extent to which migration in the United States over the period 1950–1980 is determined by these two classes of exogenous factors. © 1995 Academic Press, Inc.

I. INTRODUCTION

The interaction of migrant choices and employment growth has been a central issue for those interested in regional growth and decline for nearly 30 years. The view that differences in job growth underlie migration patterns is most frequently associated with Blanco [2] and Lowry [18], whereas the opposing claim, that differences in employment growth stem from exogenous migration variation, was formalized by Borts and Stein [5]. In addition to Muth's [19] influential analysis, important attempts to test variants of these opposing views include Greenwood and Hunt [14, 15] and Shaw [22].

That this debate on relocation has its roots in more fundamental location theory is not generally recognized. For the individual, relocation clearly occurs when the existing location becomes nonoptimal (Sjaastad [23], Graves and Linneman [12]). We argue here that, like individual migration, aggregate migration is usefully described as a reaction to disequilibrium, which itself has implications for the reestablishment of

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equilibrium. Because existing analyses have focused primarily on the determinants of migration, without considering the impact of migration on the system, they have failed to recognize the feedback mechanisms by which endogenous location factors and migration guide the system toward long-run equilibrium.

As is often the case, equilibrium is easier to understand than disequilibrium. An existing literature (Haurin [16], Roback [20], Blomquist *et al.* [3]) analyzes the equilibrium distribution of firms and households, given differences in production costs and residential desirability across locations. The failure to integrate migration flows (representing the response to disequilibrium) into an equilibrium framework has left migration to be studied in terms of a variety of ad hoc structures which leave the meaning of empirical results in question. For example, analyses such as that of Greenwood and Hunt [14], which examine the interaction between migration and employment growth, are unable to place observed migration patterns within the context of the long run spatial distribution of population. The situation is analogous to attempting to analyze the comparative dynamics of prices and quantities without first considering the comparative statics of the ultimate equilibrium. Even those studies that explicitly discuss the distinction between equilibrium and disequilibrium models of migration fail to develop a detailed formal model which incorporates these elements.[1]

In the next section, a spatial equilibrium involving profit-maximizing firms and utility-maximizing households is briefly characterized. Equilibrium implies a mix of wages, rents, and amenities such that firms earn zero profits at all locations while households obtain a common utility level. In Section III this model is extended to the case of disequilibrium, where firms and migrants consider not only current but future opportunities across locations and form fully rational expectations. We briefly characterize the dynamic structure of this model. It is disequilibrium that gives rise to relocation of households (migration) and firms (generally spatial capital flows, whether into new or existing firms). "Moving equilibrium" is also taken up here, as is the important role of factors such as shifting tastes and technology in explaining population redistribution.

In Section IV, we provide an empirical illustration based on this structure. We estimate measures of the relative importance of job opportunity versus amenities in explaining migration patterns over the period 1950–1980 for U.S. county aggregates. Section V provides a brief conclusion and speculates on the relative role of amenities and employment in inducing migration in the long run.

[1] Evans [9] is a recent example. Graves and Mueser [13] provide an extended criticism of this literature.

II. FIRM AND HOUSEHOLD EQUILIBRIUM LOCATION

Were there no variation over space in factors influencing either production costs or household utilities, one would expect to observe the same rent and wage structure in all locations. If rents were higher in a particular location, price search by both firms and households would result in movement to lower rent locations until rents equalized. Similarly, if wages were unusually high in a location, wage search would lead to a mixture of firms exiting and households entering until wages equalized. Such a featureless plain does not characterize the real world. Rather, some locations are extremely attractive to firms (e.g., those possessing rich mineral deposits or deep harbor capacities), while others are extremely attractive to households (e.g., those having pleasant climates or beautiful vistas). Locations that are attractive to households but unattractive to firms will have lower wages than elsewhere. This follows from the fact that labor supply to such locations would be greater than elsewhere, while the demand for labor would be smaller than elsewhere. The net effect on population size, and hence the demand for land, in such locations is ambiguous. As a consequence, the effect on rents is ambiguous. Locations which are attractive to firms but unattractive to households will have higher wages than elsewhere because both cost and utility must equalize across locations. Again there will be an ambiguous rent effect.

We follow Roback's [20, 21] characterization of this system. Let $U(w_i, r_i, a_i)$ be the household's indirect utility associated with residence in location i, a function of the wage w_i, the rent r_i, and the fixed location amenities a_i. Equilibrium requires that utility be equalized at some level U^* across all locations,

$$U(w_i, r_i, a_i) = U^*, \qquad \text{all } i.$$

Similarly, profits must be the same across locations. Consider for simplicity the case where all goods are traded at nationally determined prices; hence profit maximization is equivalent to cost minimization. Assuming the production function to be linearly homogeneous, and specifying $C(w_i, r_i, b_i)$ as the firm's unit cost function, with b_i a measure of location-specific factors influencing costs, cost equalization then requires

$$C(w_i, r_i, b_i) = P^*, \qquad \text{all } i,$$

where P^* is the common product price.

While these two conditions fully determine the equilibrium wage and rent as a function of exogenous factors, for present purposes it is useful to consider the condition for equilibrium in the land market. We take N_i to refer to the number of both workers and households, so that land market equilibrium in location i implies

$$L^{\mathrm{f}}(r_i; N_i, b_i) + L^{\mathrm{h}}(r_i, w_i; N_i, a_i) = L_i, \qquad \text{all } i \tag{1}$$

L^{f} is the demand for land by firms, L^{h} is the demand for land by households, and L_i is the supply of land at location i, assumed to be fixed. Given equilibrium factor prices, this implicitly defines N_i.[2]

III. DISEQUILIBRIUM

While the preceding conditions for equilibrium are straightforward, migration is properly viewed as an indication of disequilibrium. In order to model the system when it is out of equilibrium, there must be some friction that prevents population redistribution from occurring instantly. In what follows, we assume both that there are costs of migration and that firms face costs in changing their levels of employment. In both cases, we assume that such costs approach zero for low levels of adjustment, but increase with greater population redistribution or employment change. Such a structure ensures both that population redistribution takes time and that the system will approach the steady state identified above if the environment is stable for an extended period. Of course, the case where there are no migration costs, or where firms face no adjustment costs, are easily incorporated as special cases in the following.

In the treatment that follows we take net migration flow into a location to be a function of the relative utility available in that location. Letting $H_i(t)$ denote net migration at time t, we formalize the specification as

$$H_i(t) = \alpha_i \int_t^{t+T} \left[V(w_i(t'), r_i(t'), a_i(t')) - V^*(t') \right] \exp(-\rho(t'-t))\, dt' \tag{2}$$

$V(.,.,.)$ is utility per unit time, based on flows of wages and rents at location i. $V^*(t)$ may be interpreted as a measure of the flow of utility available elsewhere, which is the same for all locations in the system. The formulation assumes temporal separability with time discount rate ρ and length of life T. The above specification can be derived from migrant optimization

[2]Our treatment ignores the dynamics of labor force participation, unemployment, and household formation. As an empirical matter, differences in net migration across labor market areas over the periods we will be considering are large compared to variations in employment due to differences in unemployment or labor force participation rates. Note that in the specification for L^{f}, wage need not be included as an argument; instead L^{f} can be made conditional on employment. The profit-maximizing condition for the choice of L can be written as $\partial g(N, L, b)/\partial L = r$, where $g(N, L, b)$ is a conventional production function for the representative firm.

in which the costs of migration are weighted against future benefits in a location. A formal derivation of this model is provided in Appendix A, but a few comments on this specification are in order.

Intuitively, the specification indicates that an area that offers greater levels of opportunity than other locations will attract more migrants, while those with inferior opportunities will lose migrants. It also incorporates Sjaastad's [23] observation that migration decisions must consider gains to accrue in the future. These ideas are implicit in many of the papers that examine the determinants of migration.

In what follows, we assume that length of life is infinite, so that T can be replaced by infinity. This can be justified by assuming that the individual is part of a dynasty and that decisions will include consideration of the welfare of progeny who continue the family line. If the model were to allow for finite lives, differences in age would have to be considered, resulting in a heterogeneity across the population and increasing the model's complexity. While such heterogeneity clearly plays an important role in explaining many migration patterns, since our concern focuses on net migration that results in population redistribution, we wish to abstract from differences across people and the multiple motives underlying the many moves that occur in opposing directions.

It may appear that the time limit of the integral in (2) should correspond with the period of time that a migrant will stay in the location. This is not the case in this model, because when outside alternatives improve, migration adjusts so that an individual is indifferent between incurring moving costs and remaining in a current location. Hence, even when location desirability later declines, the future lifetime returns obtained by all current residents who later move out are the same as those who will not move.

Although not normally considered in migration research,[3] a similar expression can be formed identifying job growth. When production costs are not equal to the product price, firms increase or decrease employment at a rate determined by the profitability of production. Such a specification requires that firms face adjustment costs in altering levels of employment or output. Adjustment costs may derive from the need to train new workers, as well as the need to alter capital to accommodate a larger or smaller work force.[4]

[3]For an exception, see Vanderkamp [25].

[4]We have not allowed for economies of scale or agglomeration. Although such factors may be important at certain points in the history of population redistribution (see, for example, Arthur [1]), we focus here on more basic relations. We suspect that economies of agglomeration are generally exhausted in the processes leading to equilibrium population distribution. Our qualitative results would remain if such factors were considered.

Let us assume that land and labor are combined in fixed proportions. The easiest way to incorporate adjustment costs is to specify a fixed number of firms, each of which faces adjustment costs. Given quadratic adjustment costs, the output path for the representative firm at location $i, q_i(t'), t' > t$, will solve the problem

$$\max_{q_i} \int_t^{\infty} \left[q_i(t')(P^*(t') - C(w_i(t'), r_i(t'), b_i(t')) - \phi_i (dq_i/dt)^2 \right] \times \exp(-\rho(t'-t))\, dt', \tag{3}$$

where $P^*(t')$ is the output price and ϕ_i is a constant reflecting the size of the adjustment cost. When the expected output price exceeds cost, firms will earn short run profits, quasi-rents that accrue to being present in the location. In the short run, wages and land rents will adjust to ensure that the marginal profits of increasing employment are zero, but will not eliminate all profits.

Subject to appropriate regularity assumptions, (3) can be solved for employment growth. Taking $Q_i(t)$ to be aggregate labor demand for the full location, we have

$$\begin{aligned} J_i(t) &= d_i(dQ_i/dt) \\ &= \gamma_i \int_t^{\infty} \left[P^*(t') - C(w_i(t'), r_i(t'), b_i(t')) \right] \exp(-\rho(t'-t))\, dt', \end{aligned} \tag{4}$$

where $\gamma_i = n_i d_i / 2\phi_i$, d_i is the labor–output ratio in the location, and n_i is the number of firms.[5] $J_i(t)$ in (4) shows the rate of growth for new jobs

[5]The easiest way to obtain this solution is to reformulate the maximization (3) as a comparable discrete problem,

$$\max_{q_i(t+k\Delta t)} \sum_{k=0}^{\infty} \{ q_i(t+k\Delta t)(P^*(t+k\Delta t) - C(t+k\Delta t)) + \phi_i [(q_i(t+k\Delta t) - q_i(t+(k-1)\Delta t))/\Delta t]^2 \} \exp(-\rho k \Delta t)\, \Delta t,$$

where $q_i(t-\Delta t)$ is taken as fixed and $C(t) = C(w_i(t), r_i(t), b_i(t))$. A variant of the Euler equation is obtained by noting that the derivatives of this expression with respect to $q_i(t), q_i(t+\Delta t), \ldots,$ must each equal zero. If we discount and sum these derivatives, and rearrange, we obtain

$$(q_i(t) - q_i(t-\Delta t))/\Delta t = (1/2\phi_i) \sum_{k=0}^{\infty} [P^*(t+k\Delta t) - C(t+k\Delta t)] \exp(-\rho k \Delta t)\, \Delta t.$$

Taking $\Delta t \to 0$, summing across firms, and noting that employment is proportional to output, created by firms in location i operating according to intertemporal profit maximization. The growth rate increases as relative production costs decline and is zero when unit cost equals price for all future periods. It depends not only on present costs but on future costs as well. If firm adjustment costs are unimportant, this implies that α approaches infinity, and factor costs adjust so that production equals price at each point in time.

Equations (2) and (4) may be interpreted as supply and demand conditions, except here they identify not the stocks of labor in use but flows representing changes in levels of labor. For a given value of $N_i(t)$, continuing full employment in the location requires equality of the inflow of new workers in the location $H_i(t)$ and job growth $J_i(t)$; i.e.,

$$H_i(t) = J_i(t), \qquad \text{all } t. \tag{5}$$

Net migration and job growth are equalized by adjustments in $w_i(t')$ and $r_i(t'), t' \geq t$, joint with the time path of N_i, given exogenous factors influencing location desirability and local productivity. These factor prices ensure that, given adjustment costs, firms will maximize profits when employment grows or declines by $J_i(t)$.

Factor prices must also satisfy land market equilibrium. Given that production is a fixed proportion, (1) can be rewritten as

$$L^{\mathrm{f}}(N_i(t), b_i(t)) + L^{\mathrm{h}}(r_i(t), w_i(t); N_i(t), a_i(t)) = L_i, \qquad \text{all } t. \tag{6}$$

Unlike (1), (6) applies at all points in time, not just when the population is at equilibrium.[6]

we obtain (4). Although we have assumed identical adjustment costs across firms, we might reasonably assume that "new" firms, those with an initial production of zero, face higher initial costs associated with setting up production. Allowing for such firms will not alter the basic character of our conclusions, as long as there are some existing firms that can change output by small amounts at low cost. Expression (4) may also be derived from the assumption that expansion of production and employment by firms in a location produces congestion costs, making all production more costly. In such a case, individual firms would earn zero profits. If we allow marginal adjustment costs to be an increasing but not necessarily quadratic function, the linear structure of (4) will no longer hold, but the basic structure of our results is unchanged.

[6]It should be noted that (1) does not require fixed proportions production. However, such a more general framework leads to considerable complexity when the system is out of equilibrium. Without fixed proportions production, the derived demand for land would depend on the current (nonequilibrium) amount of land in use, not just the amount of labor employed.

Ignoring natural increase, the time derivative of N_i is net migration,

$$dN_i(t)/dt = H_i(t) = J_i(t). \tag{7}$$

This equation for the time path of population, in conjunction with (5) and (6), specifies a system with 1 degree of freedom. This is most naturally resolved by specifying $N_i(t_0)$ at some initial time t_0. The parameters $w_i(t)$, $r_i(t)$, and $N_i(t)$ are endogenous functions of time.

A useful simplification occurs under the assumption that T approaches infinity in the integral in (2). Noting that (5) holds for all t, we see that $H_i'(t) = J_i'(t)$, so that, taking the derivatives of (2) and (4), we obtain

$$\alpha_i[V(w_i(t), r_i(t), a_i(t)) - V^*(t)] = \gamma_i[P^*(t) - C(w_i(t), r_i(t), b_i(t))]. \tag{8}$$

Combining (8) with (6), we see that population and contemporaneous measures of costs and desirability ($a_i(t)$ and $b_i(t)$), in conjunction with $V^*(t)$, $P^*(t)$, and L_i, fully determine levels of wages and rents. Of course, the volume of migration at time t, as indicated in (5), is influenced by future expected changes in exogenous factors influencing productivity and location desirability.

The behavior of this dynamic model is easily explicated in terms of rent–wage space, following the analysis of the standard equilibrium model. To simplify the presentation, consider the case where $V^*(t) = V^*$ and $C^*(t) = C^*$. Line AA in Fig. 1 indicates the constant utility curve for the location, identifying combinations of wage and rent that would yield zero net migration. BB is the

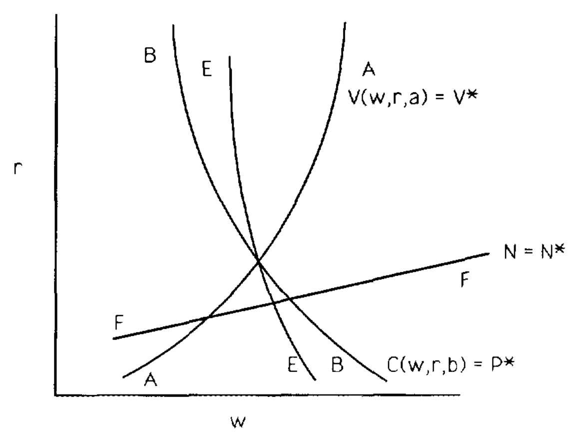

FIGURE 1

constant production cost curve, identifying points at which firms would neither increase nor decrease output. The final equilibrium is indicated by the point where these cross, establishing an equilibrium wage and rent. Given these factor prices, the final stable population can be obtained from (6).

The line EE indicates combinations of r and w that satisfy (8), i.e., combinations that produce short run equilibrium in the labor market. Noting that one side of (8) is zero along AA, while the other is zero at BB, it is clear that EE must pass through the long-term equilibrium point, with a slope bounded by these two lines. The line FF indicates equilibrium in the land market, following (6), and depends on the level of population, here labeled $N = N^*$. The intersection of EE and FF identifies the short run equilibrium. In this case, population is below the stable level. At this intersection, it is clear that V_i exceeds V^* and P^* exceeds C_i so that, based on (2) or (4), population growth is positive. As a result, the line FF shifts up, rents increase, and we observe movement up along the indicated path toward the equilibrium position.

Where the population is above the long-run equilibrium, the intersection with EE is above the long-term equilibrium level. Here net migration is negative, population declines, and movement occurs along EE from above.

The theory does not indicate whether the dynamic path EE is positively or negatively sloped. As drawn, positive net migration is associated with a decline in the wage rate, but if the response of net migration to utility differences is sufficiently large relative to the response of employment growth to cost differentials, the slope will be reversed. In fact, two polar circumstances can be identified. If migration is much more responsive than employment growth, even out of equilibrium, rent and wage levels will correspond with the constant utility locus and the adjustment path is merely a slide along AA, whereas if employment growth is much more responsive, rent and wage levels will correspond to the constant cost locus, and adjustment is along BB.[7]

Our original question focused on an attempt to identify the causal role of employment opportunity and amenities in inducing migration. The equilibrium conditions specified in Section II show that whatever the distribution of amenities and production opportunites across locations, if they are in place for an extended period, they will not induce migration. Migration is therefore best interpreted as a response to changes that disturb the equilibrium.

For example, as stressed by Graves [10] and Graves and Linneman [12], increases in income may cause households to demand greater levels of location-specific amenities, effectively causing relative utility to increase in high-amenity areas (e.g., California, Florida). High amenities then identify areas for which the AA curve shifts to the left. A discontinuous shift of this kind is illustrated in Fig. 2, showing an immediate change in the wage level

[7]This latter assumption is implicit in Topel [24].

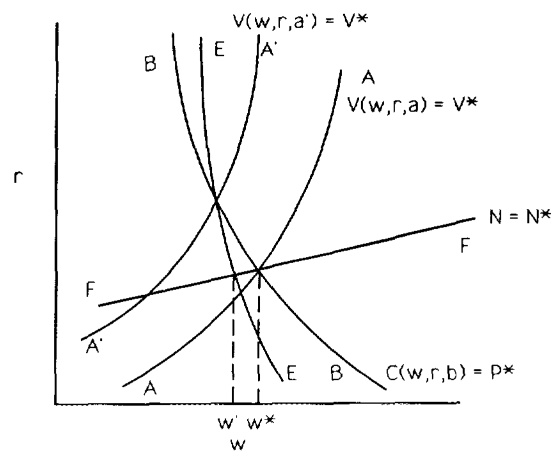

FIGURE 2

from w^* to w', and an increase in net migration.[8] Note that the instantaneous shift reduces the rent level, reflecting the fact that, with lower wages, consumer's land demand shifts in. Over time, rents increase as population growth causes aggregate land demand to shift out. In the case where such a shift is not discontinuous but rather occurs gradually over time, net migration will continue over an extended period with resulting increases in rents and reductions in wages. Of course, technological advances may cause shifts in both the AA and the BB curves, as in the case where improved low-density transportation improves both commercial opportunities and residential desirability in sparsely settled areas.

Often, we suspect, long-term migration patterns may stem from exogenous changes that are themselves gradual. In this case, migration represents a movement toward what might be referred to as a moving equilibrium; despite continued migration, the system may not be far from equilibrium at any point. For example, Graves [11] showed that net migration for U.S. metropolitan areas during the 1960s tended to be toward areas with higher housing costs. It was argued there that high rents served as a proxy for a composite amenity, identifying areas that would become desirable to migrants as incomes increased.

IV. EXPLAINING OBSERVED MIGRATION PATTERNS

To understand the original question of whether migration leads employment or employment leads migration requires an examination of the

[8] In this discussion, we ignore possible effects of such changes on (6), essentially assuming that, for a given population, land demand is independent of a and b.

relative role of exogenous factors shifting production costs and factors shifting utility. The formal model developed above helps to inform our interpretation and allows us to avoid some of the pitfalls of previous empirical analyses.

In particular, recent research often incorporates employment growth and local wage as determinants of migration (Greenwood and Hunt [15]). The above structure underscores the point that both of these are endogenous and that they are determined by shifters influencing both utility and production costs. Furthermore, the analysis shows the critical role that land rents at a location play. Researchers have implicitly assumed that employment growth or wages can be taken as measures of employment opportunity. They have seldom included land rents in their specifications. Although their estimation equations often allow simultaneous causation, in the absence of a formal model, the specifications employed are ad hoc. Reported estimates are frequently meaningless, and the interpretations misleading.

In addition, our model underscores the point that it is shifts in location desirability that induce migration. If the environment is stable and preferences are stable, even very strong preferences will not induce migration. While many researchers recognize this point, in empirical work it is still common for a positive coefficient on a desirable location characteristic (e.g., warm winter weather) in an equation predicting migration, to be interpreted as an indication of the relative importance that migrants place on this (Cushing [8]).

In the analysis that follows, we have chosen not to explicitly estimate the determination of wages and land rents. Our view is that wages and land rents are extremely difficult to measure well, because it is necessary to correct for worker and housing quality, respectively. In addition, since our concern focuses on migration, our analysis would have to consider changes in these prices over time. Changes in wages are particularly difficult to measure in the short run because employers tend to adjust effective wages by altering employment standards while they maintain nominal wage rigidity. Changes in rents are also difficult to measure, especially in areas with a large fraction of owner–occupants. For those in owner–occupied housing, implicit rent imputations must be based on both current prices and anticipated housing appreciation.

Our approach will be to focus on measures that proxy exogenous shift factors. Unfortunately, the kinds of shifts that induce migration are not directly observable. Technological changes that influence production costs and shifts that alter preferences are identifiable primarily by their effects. Any observable market change in the migration period is itself likely to be influenced by migration. Rather than attempting to directly measure the exogenous factors that alter the profitability or desirability of a location, we will employ measures that are associated with such shifts. The proportion of variance explained by factors identifying utility shifters provides an estimate of the importance of such factors, and the variance explained by those factors proxying shifts in production cost indicates the importance of jobs.

We assume that an area's industrial composition at the beginning of the decade identifies many of the changes that shift the labor demand curve. We take measures of local amenities to identify shifts in location desirability. Observed settlement patterns (populated density) and demographic measures may identify changes in either employment opportunity or location desirability.

Our geographic units are country aggregates for the United States for the three decades 1950–1980. Since our analysis views migration as a joint decision of both residence and employment, we must focus on areas which identify both residence and job location. Counties are therefore inappropriate, especially in metropolitan areas where there is appreciable commuting across borders. We also wish to have consistent units over the full three decades. We have therefore aggregated counties to form metropolitan areas based on the 1970 census.[9] Given that much recent interest has focused on nonmetropolitan migration patterns, especially in the 1970s compared with earlier periods, counties not in metropolitan areas were aggregated into State Economic Areas, as defined by Bogue and Beale [4]. State Economic Areas are constructed to include counties with relatively homogenous economic and geographic characteristics.[10]

Net migration by five-year age groups, calculated by survival methods, was available for each decade. Since our focus is on the labor force, we calculated net migration for those aged 20–65 at the end of the decade as a proportion of the populated expected in that age range in the absence of migration. The youngest migrants included in this measure are 15 at the midpoint of the decade. Although such individuals are too young to migrate independently at the beginning of the decade, we have included them in order to capture moves by those in the age range 17–20, for which migration rates are substantial. The oldest individuals begin the decade at age 55, and although a substantial portion of individuals age 55–65 move following retirement, most of those in this age range are employed.

Industrial composition reflects local characteristics that have influenced relative production costs in the past. It is likely that current changes in technology will cause shifts in productivity that are associated with these

[9] These are Standard Metropolitan Statistical Areas, except in New England, where the unit is the New England County Metropolitan Area.

[10] Data difficulties led us to exclude counties in Virginia, Hawaii, and Alaska, as well as a few dozen other counties. See Appendix B.

characteristics. In addition, even if the technology of production at a location remains unchanged, national trends in consumption by industry will shift local labor demand according to the relative importance of the industry in the area. In its simplest form, such a mechanism is identified by shift–share analysis. However, we also expect that many changes that influence employment opportunities may operate in more complex ways. For example, where the economies of agglomeration in an industry decline, employment opportunities will decline in areas where that industry is highly concentrated. As our empirical measures of industrial composition, we use the percentage of the labor force employed in manufacturing, the percentage employed in wholesale and retail trade, and the proportion of the labor force working as independent farmers. As an additional measure for capturing shifts in labor demand, we also employ a dummy indicating whether the area includes a state capital.

Climate data are expected to identify changes in location desirability if the relative importance that propsective migrants place on such factors shifts. As noted above, if local amenities are normal goods, increases in income should cause an increase in the demand for amenities; we expect them to grow more important in relocation decisions. As measures of climate, we have average temperatures in January and in July, and average July humidity, sunlight, and rainfall.[11] As an indicator of recreational value, we have the percentage of area that exists as lakes.

The settlement structure in an area is strongly associated with migration patterns over time. We believe this may reflect shifting economies (or diseconomies) of agglomeration in production and/or in residential consumption, so that this association tells us little about the relative importance of employment and amenities. However, since settlement structure may be correlated with industrial structure or amenity measures, the omission of such measures could bias the estimates of impacts. In order to control for the effects of settlement patterns, we employ population density, metropolitan status, and the distance from a metropolitan area with a population of at least 1 million.

We also include the proportion of the population that is black and median education. These reflect past movements and human capital accumulation in the location. Areas with more educated populations are likely to specialize in particular kinds of production, suggesting that this

[11]Of course, climate influences production as well as residential desirability. We hypothesize that the importance of climate in production is less likely to change over time. While the advent of air conditioning undoubtedly improved productivity in areas with hot summers, the analysis reported below shows movement toward areas with cool summer temperatures, the reverse of the effect resulting from greater availability of air conditioning. This suggests that growth of income and the resulting increased migrant movement toward more pleasant climates overwhelmed effects due to air conditioning.

measure may identify shifts in employment demand. On the other hand, there is some evidence that movement by educated populations, which are likely to have higher incomes, may identify particularly attractive locations. Similarly, differences in racial composition identify variation in human capital and wealth that remain even after education is controlled. Like education, race may be associated with either employment demand or location attractiveness shifters.

In addition, we need to control for the age composition of the population. Migration propensity varies dramatically by age, so that those locations with a particularly large proportion of population in the primary migration ages will be more likely to lose migrants simply because their populations are more mobile. Based on five-year intercounty migration rates, we have used the observed age composition in the location to construct a measure of the proportion of the population expected to cross a county border during the decade, which we refer to as local departure propensity.

Collinearity between measures within each of our categories makes it difficult to interpret coefficient estimates when all available measures are included as measures predicting migration. In particular, the correlation between the proportion of employment in manufacturing and in wholesale–retail sales is −0.7 in some decades. Similarly, several of the measures of climate are highly correlated; when all taken together as predictors of migration, estimates contain much error. We therefore present models for which a subset of available variables have been chosen to represent each category.[12]

Table 1 presents ordinary least-squares estimates of models predicting the net migration rate for each of the three decades. We see, in each case, the proxy for local population mobility propensity has an appreciable effect on migration. Those areas with populations in the most migration-prone ages are much more likely to experience migration loss.

Industrial composition is captured by the proportion of employment in manufacturing and the importance of agriculture. In the case of the former, the effects are permitted to differ by metropolitan status. We see that for each decade, high levels of manufacturing in a metropolitan area are associated with lower migration. For nonmetropolitan areas, in the

[12]For comparability, all models reported in Tables 1 and 3 include the same independent variables. In general, the variables chosen are the most important in terms of contribution to explained variance across the five models. However, in some cases a variable that would have contributed appreciably to explained variance is excluded because its collinearity with other measures made estimates difficult to interpret. Alternative specifications yield similar substantive conclusions. In Tables 2 and 4 we report results based on models that include any variable that is statistically significant. In all models reported, F statistics are highly significant.

TABLE 1

Determinants of Net Migration Rate: 520 U.S. County Aggregates

	1950–1960 (1)		1960–1970 (2)		1970–1980 (3)	
	B	*t*	*B*	*t*	*B*	*t*
Intercept	89.840		33.374		111.835	
Local departure propensity	−3.767	−6.3	−1.390	−3.0	−2.550	−4.9
Employment related						
Metropolitan manufacturing	−0.264	−3.4	−0.125	−1.7	−0.433	−5.0
Nonmetro manufacturing	−0.079	−0.9	0.175	2.5	−0.146	−1.9
Agriculture	−0.383	−4.1	0.153	1.6	−0.280	−2.3
Amenities						
January temperature	1.124	10.5	0.708	8.1	0.780	8.1
July temperature	−0.549	−2.5	−0.655	−3.6	−0.607	−3.1
Percent lakes	0.072	0.5	0.069	0.6	0.212	1.6
Settlement patterns						
Metropolitan	11.004	8.1	3.960	3.5	−3.707	−3.0
Metropolitan density	−0.0029	−2.0	−0.0006	−0.4	−0.0036	−2.4
Nonmetro density	0.023	0.6	0.060	2.3	−0.042	−1.8
Demographic						
Percent black	−0.100	−1.6	−0.134	−2.6	−0.397	−6.5
Median education	4.765	6.9	4.256	7.5	1.962	2.7
R^2	⟨0.6395⟩		⟨0.4564⟩		⟨0.4677⟩	

Note. Eight dummies for the nine census divisions are also included. For variable definitions and sample description, see Appendix B.

second decade manufacturing employment is associated with greater levels of migration. The association is reversed in the other decades, although it is statistically significant only in the 1980s. Agriculture (which only applies to nonmetropolitan counties) is strongly associated with migration loss in the first and third decade, but not in the second.

Among the amenity variables, movement is as would be predicted if desirable climates had been growing more important in migrants' decision making. Higher winter temperatures and low summer temperatures are associated with higher levels of migration. Interestingly, there is no evidence that the effect is growing stronger over time. This is consistent with an extended period of income growth, over which climate becomes gradually more important. The coefficient suggests that areas with more lakes have higher rates of migration in the third decade, although the effect only borders on statistical significance.

Finally, we see that the effects of location density on migration differed over the decades. The dummy variable for metropolitan status shows that metropolitan areas were gaining migrants faster than nonmetropolitan areas in the 1950s, that the advantage had declined greatly by the 1960s, and that by the 1970s, metropolitan areas were experiencing a migration deficit.[13] Finally, the demographic variables suggest that migration occurred toward areas with fewer blacks and more highly educated population over the three decades. This could reflect relatively greater growth in those industries employing more skilled workers or continued movement by the privileged toward particularly desirable areas.

The results in Table 1 demonstrate that migration is affected by factors shifting both employment opportunity and migration draw. However, given scaling differences and the correlations between related measures, simple coefficient estimates do not allow comparison of the relative importance of the measures. In order to gauge overall impacts of the various classes of variables, we have calculated for each group a standardized coefficient that measures the contribution of those measures taken together.[14]

Table 2 presents such group coefficients for equations predicting net migration over the three decades. Odd-numbered columns indicate coefficients for prediction equations reported in Table 1, while even-numbered columns report coefficients corresponding to an expanded model that enters any additional variables in each category that border on statistical significance. It is clear that allowing for additional measures does little to alter the relative rankings of importance.

The group coefficient for employment-related variables is between 0.13 and 0.28, while that for amenities is usually over 0.5. This would suggest that amenities play a more important role in explaining migration patterns. Over this period, however, settlement patterns and demographic

[13]Note that although density is clearly endogenous, the sharp changes between decades identify exogenous changes in its impact. Of course, it is unclear whether social and technological changes made high-density residential life relatively less desirable or whether these changes worked through the labor market.

[14]If a single variable were constructed from those variables listed in the group based on their estimated coefficients, this group coefficient would be the standardized coefficient associated with this constructed variable. It identifies the impact of a one-standard-deviation increase in the constructed measure on the dependent variable, also scaled in terms of its standard deviation. It can be calculated as $[\Sigma_i \Sigma_j b_i b_j \operatorname{cov}(X_i, X_j)]^{1/2}/S_Z$, where b_i is the estimated coefficient for independent variable X_i, $\operatorname{cov}(X_i, X_j)$ is the covariance between X_i and X_j ($\operatorname{cov}(X_i, X_i) = \operatorname{var}(X_i)$), and S_Z is the standard deviation of the dependent variable. Since this construction exploits estimation error, it must overestimate the actual impact of a group of variables. Although this systematic bias is unlikely to be large enough to alter substantive conclusions, the coefficient is most reliable as a measure of relative importance.

TABLE 2

Relative Impact of Groups of Measures on Area Net Migration Rate

	1950–1960		1960–1970		1970–1980	
	(1)	(2)	(3)	(4)	(5)	(6)
Local departure propensity	0.237	0.201	0.126	0.041	0.189	0.150
Employment related	0.184	0.185	0.131	0.152	0.242	0.284
Amenities	0.592	0.557	0.505	0.448	0.523	0.508
Settlement patterns	0.279	0.307	0.174	0.383	0.166	0.171
Demographic	0.348	0.311	0.471	0.479	0.387	0.363
Nine census divisions	0.326	0.259	0.188	0.194	0.243	0.271
R^2	0.6395	0.6794	0.4564	0.5640	0.4677	0.5129

factors also appear to be of appreciable importance. If these reflect job opportunity (i.e., if they have their impact primarily because they identify shifts in labor demand), the role of employment opportunity was greater than this comparison suggests. The group coefficient for variables listed as employment related and settlement patterns, taken together, ranges from 0.30 to 0.36. If demographic variables are included as well, the group coefficient ranges from 0.47 to 0.70. While these comparisons show that employment opportunity may have played an important role, amenities were clearly no less important and may have actually played a greater role.

As noted in the previous section, the observed impact on migration of the independent variables reflects their association with changes in exogenous factors and expectations occurring not only during the period in which migration is observed but also with previous changes as well. That is, the coefficient of each variable identifies not a change at a particular point in time, but the weighted sum of changes. How such weighting occurs is determined by how fast movement toward equilibrium is.

Table 3 presents coefficients of a model that attempts to identify changes occurring over a shorter period. This formulation uses the difference in net migration for two successive periods as the dependent variable. The theory indicates that changes in migration between two successive periods is a function of (i) movement toward equilibrium and (ii) exogeneous changes in shift variables. Movement toward equilibrium is captured by population change over the first period. As in the earlier specification, we have no direct measure indicating changes in exogenous shift factors, so we proxy the shifts in supply and demand with the same measures used above, as observed at the end of the first period. We have also entered the simple difference in the local departure propensity in the decades as an independent variable.

TABLE 3
Determinants of Changes in Net Migration: 520 U.S. County Aggregate.

	(1) 1950–1960 to 1960–1970		(2) 1960–1970 to 1970–1980	
	B	*t*	*B*	*t*
Intercept	19.544		36.208	
First decade growth	−0.713	−19.7	−0.397	−8.7
Local departure propensity	−0.766	−0.7	−4.958	−5.9
Employment related				
Metropolitan manufacturing	−0.073	−1.1	−0.322	−4.8
Nonmetro manufacturing	0.215	3.5	−0.233	−3.8
Agriculture	0.269	3.1	−0.266	−2.7
Amenities				
January temperature	0.309	3.5	0.297	3.5
July temperature	−0.450	−2.7	−0.154	−0.9
Percent lakes	−0.001	−0.0	0.233	2.2
Settlement patterns				
Metropolitan	−0.174	−0.2	−5.705	−5.5
Metropolitan density	−0.0007	−0.5	−0.0040	−3.2
Nonmetro density	0.031	1.3	−0.087	−4.5
Demographic				
Percent black	−0.045	−0.9	−0.263	−5.3
Median education	1.251	2.3	−0.982	−1.5
R^2	0.6314		0.6034	

Note. Eight dummies for the nine census divisions are also included.

Column 1 in Table 3 reports estimates of a model based on the difference between the first and the second decades, and column 2 presents a model based on the difference between the second and the third. Table 4 presents group coefficients for difference equations. Odd-numbered columns refer to equations reported in Table 3, while even-numbered columns report results with extended models. These results may be interpreted as indicating the relative importance of changes in exogenous factors between the successive decades. The coefficients have the same basic patterns as those in Tables 1 and 2, since both specifications use the same measures to proxy changes in exogenous factors. However, a number of differences are of interest.

In the odd-numbered columns of Table 4, employment-related measures, taken together, are only slightly less important than the amenity

TABLE 4
Relative Impact of Groups of Measures on Change in Area Net Migration

	1950–1960 to 1960–1970		1960–1970 to 1970–1980	
	(1)	(2)	(3)	(4)
First decade growth	0.865	0.848	0.345	0.320
Local departure propensity	0.030	0.025	0.238	0.255
Employment related	0.140	0.185	0.222	0.255
Amenities	0.189	0.291	0.240	0.342
Settlement patterns	0.048	0.139	0.270	0.263
Demographic	0.130	0.159	0.198	0.162
Nine census divisions	0.139	0.310	0.244	0.189
R^2	0.6314	0.6944	0.6034	0.6241

measures, in contrast to the large difference apparent in comparable regressions reported in Table 2. This highlights the way in which the two specifications relate. If moderate climates became progressively more attractive over an extended period of time, locations with desirable climates would continue to attract increased numbers of migrants over successive decades. Climate could be an important predictor of period migration even if the changes observed between any pair of consecutive decades were modest. In contrast, if those areas experiencing shifts in employment opportunity differed from decade to decade, the cumulative impact on observed migration would be smaller. In fact, focusing on the composite amenity measure in columns 1 and 3 of Table 4, we find a correlation of 0.8, suggesting that the same areas were becoming more desirable for migrants over the three decades. The composite of employment-related variables for specifications in columns 1 and 3 have a correlation of -0.4, suggesting that areas experiencing growth in employment opportunity over the first two decades tended to experience declines from the second to the third.

V CONCLUDING REMARKS

In the most general terms, these results illustrated that there is no "final" answer to the question of causal impact in migration: while profit-shifting variables may be relatively more important in one period, in the next, utility-shifting variables may emerge as more important. Furthermore, shifts occurring over time have a cumulative effect on observed migration, so that shifts occurring at one point in time may either accentuate or cancel the impacts of earlier shifts.

Our discussion suggests that useful models of migration may build on the tendencies for compensating differentials in land and labor markets to develop, making firms and households indifferent to location. Conclusions of existing studies regarding the role of employment growth in inducing migration are suspect because they fail to take into account such issues.

We suspect that the relative importance of shifts in employment-related factors versus shifts in migration choices will depend on the time span being considered. In particular, industry-specific effects (e.g., an exogenous drop in oil prices affecting Texas; environmental controls affecting steel production costs; spatially varying demand impacts of recessions) may be relatively important in the short run. But if areas that benefit by such effects in one decade are not the same as those that benefit in successive decades, the cumulative impact of these effects will be muted. This is what appears to have occurred over the period considered here.

In contrast, systematic migration trends observed over several decades appear to have been tied to household preferences for amenities, in conjunction with changes in income or technology that increase the importance of such factors. While such shifts occurred slowly in any one decade, the same locations appear to have grown in attraction over an extended period. The impact on population distribution may be dominant.

APPENDIX A: THE BEHAVIORAL STRUCTURE OF MIGRANT DECISIONS

The behavioral structure underlying (2) in the text rests on the basic idea that costs of movement prevent migration from equalizing opportunities across locations instantaneously. Although such patterns could stem from heterogeneity in moving costs across individuals, the simplest basis for such a model assumes identical individuals but with moving costs per migrant directly tied to the level of net migration. (If moving costs were positive and constant rather than increasing with migration, migration would not occur if utility differences were less than this cost, so utility equalization posited in the equilibrium model would not occur.)

Let the total cost of movement between locations for an individual or a household be the simple sum of costs that depend on the departure location and costs that depend on the arrival location. For arrival location j, with net migration $H_j > 0$, the contribution to moving costs is taken to be $m_j(H_j) > 0$, while for departure location i, $H_i < 0$, the contribution to moving costs is $-m_i(H_i) > 0$. The total cost for an individual who moves from i to j is $m_{ij}(H_i, H_j) = -m_i(H_i) + m_j(H_j)$. We take $m_i' > 0$ and $m_i(0) = 0$, for all i.

This formulation implies that movement out of a faster declining area is more costly ($dm_{ij}/d|H_i| > 0$, for $H_i < 0$). Such a relationship reflects the problems of leaving an area when many others are also leaving, perhaps stemming in part from the need to sell property in a distressed market. The cost of moving into an area also is greater when net migration is higher ($dm_{ij}/dH_j > 0$, for $H_j > 0$), due to increasing marginal costs of accommodating greater numbers of new arrivals.

For a pair of locations, i and j, with $H_i < 0$ and $H_j > 0$, given homogeneous individuals, moving costs must exactly compensate for the expected utility differential; i.e.,

$$U_i(t) = U_j(t) - \left(-m_i(H_i(t)) + m_j(H_j(t))\right), \tag{A1}$$

$U_i(t)$ and $U_j(t)$ are the future lifetime discounted utilities from residing in location i or j at time t. This may be taken to include the possibility of later moves from either location. However, since the population is homogeneous, the utility from remaining in a location indefinitely must be the same as for those who choose to leave at some future time. Hence, we can write

$$U_i(t) = \int_t^{t+T} V(w_i(t'), r_i(t'), a_i(t'))\exp(-\rho(t'-t))\, dt',$$

where T is the length of life. Since expression (A1) must apply to all such pairs of locations, this implies that there is a $U^*(t)$ such that

$$U_i(t) - m_i(H_i(t)) - U^*(t), \qquad \text{all } i. \tag{A2}$$

$U^*(t)$ and equilibrium net migration rates $H_i(t)$ are determined by (A2), and the condition that total net migration in the system must be zero, i.e.,

$$\sum_i H_i(t) = 0.$$

If we solve (A2) for $H_i(t)$, we obtain

$$H_i(t) = m_i^{-1}(U_i(t) - U^*(t)).$$

Defining $V^*(t)$ so that

$$U^*(t) = \int_t^{t+T} V^*(t')\exp(-\rho(t'-t))\, dt'$$

and taking the linear approximation

$$m_i^{-1}(x) = \alpha_i x,$$

we obtain (2) in the text. If we retain a possible nonlinear structure of $m(x)$, the linear relationship in (2) no longer holds, but the basic results are largely unaffected.

APPENDIX B: DATA

Units of Analysis

Analyses were performed on 520 county aggregates, including 236 metropolitan units based on the 1970 county classification of the Brown–Hines file (Hines *et al.* [17]) and 284 units outside these metropolitan areas corresponding to State Economic Areas (Bogue and Beale [4]). The initial aggregation of counties produced 553 units. However, usable data were missing for many of the component counties, including all counties in Virginia, Alaska, and Hawaii. We chose to eliminate any unit for which counties representing half of the population were missing usable data on any variable. This reduced the number of county aggregates to 527. In addition, 7 aggregates for which net migration exceeded 1.0 in any decade were omitted. Although inclusion of these areas would have altered several coefficients and increased estimates of standard errors, substantive conclusions would not have been altered.

Variable Definitions

Migration and Population Growth

Net migration rate. Calculated for each decade as the estimated number of net migrants aged 20–65 at the end of the period divided by the population aged 20–65 expected in the absence of migration, expressed as a percentage.

Growth rate. Calculated for each decade as the change in population aged 20–65 divided by the population aged 20–65 expected in the absence of migration, expressed as a percentage.

Local departure propensity. The percentage of the population aged 10–55 at the beginning of the decade expected to cross a county boundary by the end of the decade based on age composition. The measure is calculated by weighting the U.S. age-specific migration propensity (from aggregated responses to the census question regarding residence five years earlier) by the proportion of the local population in each age group.

Employment Related

Metropolitan manufacturing. Percentage of the employed civilian labor force in manufacturing at the beginning of the decade, minus the mean for metropolitan county aggregates. Nonmetropolitan areas are coded 0.

Nonmetropolitan manufacturing. Percentage of the employed civilian labor force in manufacturing at the beginning of the decade, minus the mean for nonmetropolitan county aggregates. Metropolitan areas are coded 0.

Agriculture. Percentage of the employed civilian labor force for nonmetropolitan areas employed as independent farmers at the beginning of the decade. Metropolitan areas are coded 0.

Metropolitan wholesale and retail trade. Percentage of the employed civilian labor force employed in wholesale and retail trade at the beginning of the decade, minus the mean for metropolitan areas. Nonmetropolitan areas are coded 0.

Nonmetropolitan wholesale and retail trade. Percentage of the employed civilian labor force employed in wholesale and retail trade at the beginning of the decade, minus the mean for nonmetropolitan areas. Metropolitan areas are coded 0.

State capital. Coded 1 if area contains a state capital, and 0 otherwise.

Amenities

January temperature, *July temperature*. Average 1941–1970 temperatures in °F.

January sunlight, *July sunlight*. Average 1941–1970 sunlight in hours.

Annual precipitation. Average 1941–1970 precipitation in inches.

January humidity, *July humidity*. Average 1941–1970 humidity in percent.

Percent lakes. Percentage of area which is covered by lakes.

Settlement Patterns and Demographics

Metropolitan/nonmetropolitan. Official classification for counties based on the 1970 census.

Metropolitan density. Population aged 20–64 divided by land area, minus the metropolitan mean. Nonmetropolitan areas are coded 0.

Nonmetropolitan density. Population aged 20–64 divided by land area, minus the nonmetropolitan mean. Metropolitan areas are coded 0.

Distance to major urban area. Average distance from county centroids in area, in miles, to a metropolitan area of a population of 1 million or more, based on 1970 population figures. Coded 0 for metropolitan areas of a population of 1 million or more.

Percent black. Percent of total population coded as black at the beginning of the decade.

Median education. Estimated median education for population aged 25 or over at the beginning of the decade. Calculated as a weighted mean of reported county median educations, with each county's median weighted by the population aged 20–65 in that country.

Census divisions. Eight dummies represent nine U.S. census divisions: New England, Mid-Atlantic, East North Central, West North Central, East South Central, West South Central, Mountain, Pacific, and South Atlantic (omitted category).

Data Sources

Net migration for 1950–1960 and 1960–1970 are modified census survival estimates produced by Gladys Bowles and colleagues from decennial census population counts and vital statistics for counties (Bowles and Tarver [7], Bowles *et al.* [6]). Estimates for 1970–1980 were calculated using a similar methodology, but with a correction for different undercount by age, race, and sex (White *et al.* [26]). Data sets containing these estimates are available through the Interuniversity Consortium for Political and Social Research, University of Michigan, Ann Arbor.

Estimates of manufacturing and wholesale–retail trade employment are from the decennial census, as are measures of race and education. Counts of farmers are from special agricultural censuses. These were taken from the County and City Data Book files and from the Summary Tape File 3 of the Census of Population and Housing, 1980.

Climate data are from the area Resource File, and percent lakes is from the Area Measurement File, both included in the National County Data Base by the Center For Social Data Analysis, University of Montana, Bozeman.

The classification of metropolitan/nonmetropolitan status is from the Brown–Hines file (Hines *et al.* [17]).

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