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Location-Specific Human Capital,
Location Choice and Amenity Valuation

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ABSTRACT

The role of amenities in the flow of migrants has been debated for some years. This paper advances a model of amenities that work through household production instead of directly through the utility function. Area characteristics (amenities) affect the household production function, causing certain kinds of human capital to be relatively more highly rewarded. Area heterogeneity makes such investments specific to certain areas. Specificity increases opportunity costs to moving and diminishes migration between dissimilar locations. Tests of the model's using the NLSY79 support the hypothesis that childhood investments affect migration flows in the way proposed by the model.

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Introduction.

People move for many reasons. Certainly life-cycle considerations and regional income differences have substantial effects on human migration, but a host of finer considerations influences individuals' decisions to relocate perhaps as much.¹ Specifically, spatial differences in the returns to a person's human capital will influence a population's spatial distribution at the aggregate and people's location/migration decisions at the individual level. Intuitively, such differences should play an important role in determining people's migration decisions by affecting their relative real income in various places. The loss of returns on locally effective human capital at original locations probably constitutes an important part of the costs of human migration.

This paper uses the concept of location-specific human capital to build on previous work on amenities, human capital, migration, and regional labor market dynamics to develop a simple model of people's migration behavior. After reviewing the literature, Section II advances a model in which attainable utility levels vary over space because of differences in labor market conditions and in technologies available for generating the household commodities from which people derive utility. These technological differences are interpreted as arising from differences in area characteristics (amenities), which reward certain kinds of knowledge more than others. People can migrate to arbitrage away the utility differentials, but only after a period of forced residence in the area to which they were randomly assigned. This random assignment is interpreted as birth, and the period of forced residence is interpreted as a person's childhood and early adolescence, a time during which people must take their location as given.

¹ Graves [1979], Grave & Linemman [1979], Graves & Regulska [1982], Tolley [1974], Tolley, Rudzitis and Baden [1999], Mincer [1978], Greenwood *et. al.* [1991], DaVanzo [1983] and Dynarski [1981] are all examples from the migration literature that look at other factors of migration besides price-adjusted income.

Whatever a person's tastes or natural abilities, this period of forced residence makes the acquisition of at least some locally-favored human capital optimal, even if the person plans to move to another area once the period of forced residence is over. These increased investments in locally favored forms of human capital in turn increase the opportunity cost of migrating to dissimilar areas, thus diminishing the flow of migrants and retarding the equalization of attainable utility across areas (labor market equilibrium) and increasing people's willingness to pay to live in areas with characteristics similar to the ones in which they grew up.

Section III outlines the strategy for an empirical test of the theory advanced in the second section. Specifically, the prediction that people will attempt to keep the characteristics of their environment stable and similar to those they grew accustomed to when they came of age will be tested against the prediction of a standard model of amenity valuation where amenities are simply valued for their own sake, and not through their effects on household production. The prediction of the standard model is simply that, for normal goods, people with greater command of resources will demand more public goods than poorer people.

The test of these conflicting theories is carried out in Section IV using confidential geocoded data from the National Longitudinal Survey of Youth, 1979 cohort. By merging county characteristics to the youths' records, we can directly test the implication that people attempt to stay in places similar to ones in which they have experience and whether income is a significant predictor of amenity demand. The results – presented in Section IV – are very favorable: prior exposure is the primary determinant of amenity demand. A brief fifth section concludes.

I. Literature Review.

The literature on migration is extensive. Sjaasted [1962] was the first to bring migration

into the framework of investments in human capital, but it has always been clear that migration is driven by economic forces. A recent review of this literature is Greenwood [1997]. Tolley [1974] and Rosen [1974] offer models which include such forces, but allow amenities to play a part in reaching regional equilibrium. Roback [1982] applied hedonic analysis to cities and a series of attempts to develop all-inclusive quality-of-life indexes for metropolitan areas followed. This literature is reviewed by Gyourko *et al.* [1997].

Another branch of this literature concerns the effect of amenities on migration *per se*. Graves [1979] and Graves *et al.* [1979, 1982] show evidence that amenities effect people's location decisions. Some authors [Florida 2000a, b, c, Clark 2002] have focused on urban and cultural amenities as driving regional growth. Such a conclusion suggests that amenities have not yet been fully capitalized into wages or rents. Greenwood *et al.* [1991] allow for such disequilibrium forces in computing state-level compensating differentials. Using better data, however, Greenwood *et al.* [1989] show that amenities perform relatively poorly compared to more standard labor-market variables in predicting migration flows.

The realization that compensating differentials must come from varying returns to human capital investments was apparent from the beginning, as the above authors make clear and as acknowledged by Cragg and Kahn [1997], who allow returns to human capital to vary across states. But a complete understanding of inter-regional wage differentials must also be based on an understanding of inter-regional differences in the distribution *and type* of human capital. The point of departure in this paper is to acknowledge the existence of types of human capital whose returns are location-specific. The idea of location-specificity in human capital is not new. Sjaasted [1962], Becker [1964, p. 50], and Davanzo [1982] all use or acknowledge its existence.

Many other types of specificity have been proposed. Becker, *et al.* [1977] propose

spouse-specific human capital as a tempering factor in divorce. Neal [1995, 1999] uses industry-specificity to understand job search strategies. All of these types of capital, however, can have significant spatial implications. Industry-specific human capital, for example, will be location-specific if industries are non-uniformly distributed. Spouse-specific knowledge is location-specific as well, if the spouse does not wish to move. Mincer [1978] and Graves and Linneman [1979] show that marital status has significant effects on the propensity of people to migrate. Large amounts of firm-specific human capital would likely have a similar effect, as shown by Bartel [1979] (one of the motivating factors in Zax [1994]). Most of the concept of social capital (at least as described in Putnam [2000] and Glaeser *et al.* (2002)) also manifests itself as location-specific human capital.

This paper attempts to systematize the concept of location-specific human capital referred to in the above papers, and advance on a relatively newer line of the amenity literature. Hsu [1995] posits the existence of unobserved amenities for which time-intensive investments are required to develop a taste. His empirical results are suggestive. Taking the next logical step, Tolley, Rudzitis and Baden [1999] formalize Hsu's familiarity amenity. They develop an extensive model, allowing for investments in this amenity, and provide evidence suggesting that it could be an important factor in the migration decision of certain subsets of the population. This paper takes the Tolley *et al.* analysis one step further by separating sense of place from the standard amenities, treating it purely as an investment in location-specific human capital, and drawing out the implications for amenity demand.

II. Model.

In this section, a formal model is developed capturing the following essential elements: exogenous origin, availability of investments of variable geographic specificity, the possibility of

migration and inter-regional wage differentials. Subsection A describes the assumptions of model and subsection B draws several results. A third subsection extends the model to multiple locations. These results are compared with those of the previous literature in Section III.

A. Location-specific Human Capital.

By assumption there are two periods (1, 2) and two locations (A , B). Individuals are assigned randomly at the beginning of the first period to the first of the two locations with probability $\pi \in [0, 1]$, so that a π proportion of the population lives in location A at the beginning of the first period and a $(1-\pi)$ proportion live in location B . Individuals are stuck at their assigned location for the first period, but have the option of switching locations (migrating) between periods.

We assume that individuals maximize their expected real income (W) over the two periods by making investments in two types of human capital: H_A and H_B . Both forms of human capital exhibit declining marginal returns. The income in any period and at any location is assumed to be declining in the proportion of people living at that location in that period,² and increasing in human capital investments. For tractability, it is assumed that the effects of the two types of human capital are additively separable, and that income is made of a systematic and idiosyncratic component. A simple, tractable functional form that embodies these assumptions is:³

² This unrealistic representation of the local labor market effects is not problematic since the model is not intended to describe or predict regional growth. The proportion of population (π), as it enters in this model, provides the following essential features to the analysis: it allows for inter-area differences in the returns to human capital; as a result, it gives an incentive to migrate from one area to another; finally, it also provides an equilibrating mechanism – through migration – by which it is not optimal for the whole population of one area to migrate to the other.

³ The model is presented here using a specific functional form. Results of the same model with a more general functional form (which are qualitatively similar, but not as strong) are available in Krupka [2004].

$$(1) \quad W_A(H_A, H_B; \pi, \alpha) = \frac{\alpha \ln H_A + (1 - \alpha) \ln H_B}{\pi} + e_a$$

$$(2) \quad W_B(H_A, H_B; \pi, \beta) = \frac{(1 - \beta) \ln H_A + \beta \ln H_B}{(1 - \pi)} + e_b,$$

where $e_a, e_b \sim N(0, \sigma_e)$, $E(e_a e_b) = 0$, $\pi \in [0, 1]$, and $\alpha, \beta \in [1/2, 1]$. The random errors (e_a, e_b) represent the idiosyncratic match individuals find in their respective locations and correspond to un-modeled taste for the area. These idiosyncratic components of wage are assumed independent for simplicity, but all the results of the model hold when they are correlated. It is assumed that individuals know their random component of income at their origin location at the beginning of the first period, but not in the other location. The only way individuals can get a new draw on this component is by moving from one location to another. *Alpha* and *Beta* are the level of specificity that the human capital technology exhibits. If *Alpha* and *Beta* are one, human capital is useless outside of its region (it has no effect on income in the other region). If *Alpha* and *Beta* are $1/2$, there is no specificity. The populations of each area (π and $1 - \pi$) allow for inter-area income differences and incentives for migration.

Given the above technology, individuals maximize their two-period income over the two human capital choice variables and the decision of whether or not to migrate. Assuming no capital constraints, a discount factor of δ ,⁴ capital shadow prices of p_a and p_b , respectively for H_A and H_B , the optimal levels of human capital investment will depend upon whether the individual chooses to move or not. Because income levels depend upon the size of the population, optimal investment in human capital will also depend upon the amount of people living at locations *A* and *B* in the second period (π' and $1 - \pi'$, respectively), after migration decisions have been made. Equations 3 and 4 represent the individual's optimization problems.

$$(3) \quad \text{if not moving: } \max_{H_A H_B} W_A(H_A, H_B; \pi, \alpha) + \delta W_A(H_A, H_B; \pi', \alpha) - p_a H_A - p_b H_B$$

$$(4) \quad \text{if moving: } \max_{H_A H_B} W_A(H_A, H_B; \pi, \alpha) + \delta W_B(H_A, H_B; \pi', \beta) - p_a H_A - p_b H_B$$

An individual planning to stay (represented by super-script *S*) both periods at location *A* will

⁴ δ need not be less than one: if the second period is much longer than the first, δ could be greater than one.

optimally acquire $[H_A^S, H_B^S]$ levels of human capital, while individuals planning to move will wish to invest $[H_A^M, H_B^M]$. The optimal investment levels are easily derived, and are functions of the period one and two populations, δ , prices and the human capital specificity parameters (α and β). Unsurprisingly, people in a high-returns region ($\pi < 1/2$) will be more educated than people in a low-returns region ($\pi > 1/2$), and optimal levels of investments are inversely related to the price of the investments.

Whether an individual at location A is a stayer or a mover depends on whether his expected income (present value of income minus capital expenses) as a mover is greater than or less than his expected income as a stayer. That is, it will depend on whether the *Net Income of Staying* at location A (NW_S^A) is greater or less than zero.

$$\begin{aligned}
 (5) \quad NW_S^A &= Net\ Income_S - Net\ Income_M = \\
 &[(1+\delta)W_A(H_A^S, H_B^S) - p_a H_A^S - p_b H_B^S + (1+\delta)e_a] \\
 &- [W_A(H_A^M, H_B^M) + \delta W_B(H_A^M, H_B^M) - p_a H_A^M - p_b H_B^M + e_a + \delta e_b]
 \end{aligned}$$

The substitution of the optimal investment levels ($[H_A^S, H_B^S]$ and $[H_A^M, H_B^M]$) into equation five yields a long and relatively unwieldy equation. The NW_S^A equation is equivalent to the opportunity cost of migrating from location A to location B in terms of the parameters of the model, assuming optimizing behavior. If this term is positive, the income of staying is higher than the income of moving, and the individual will decide to stay in location A . Otherwise, the individual moves from location A to B between periods. The condition for individuals whose origin is at location B is similar.

B. Theoretical Results.

The primary result derived from the model is that, when returns to human capital are location-specific, first and second period residence will be correlated, even when moving costs are zero.

Assuming no location specificity ($\alpha = \beta = 1/2$), no migration costs ($E(e_b) = 0$), and equal first period populations ($\pi = 1/2$), the NW_S^A in equation five reduces to $\delta e_a \sim N(0, \delta \sigma_e)$.⁵ In this situation, exactly half the population migrates out of each area,⁶ and first and second period residence are not correlated. This is our benchmark: in the absence of location-specificity, moving costs or labor market disequilibrium, second-period location is determined solely by idiosyncratic taste for the areas.

Location-specificity ($\alpha = \beta > 1/2$) decreases the incentive to migrate, lowering migration flows and making people more likely to stay in their “home” area. We arrive at this result by setting $\alpha = \beta$ for convenience, and differentiating with respect to α . This yields equation six:

$$\begin{aligned}
 \frac{\partial NW_S^A}{\partial \alpha} &= \left[\frac{1}{\pi} + \frac{\delta}{\pi'} \right] \left[\ln \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) - \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) \right] \\
 (6) \quad &+ \left[\frac{1}{\pi} - \frac{\delta}{(1-\pi')} \right] \left[\ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')} \right) - \ln \left(\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')} \right) \right] \\
 &+ \left[\frac{\delta}{(1-\pi')} + \frac{\delta}{\pi'} \right] (\ln p_b - \ln p_a).
 \end{aligned}$$

Equation six is positive whenever $\alpha > 1/2$, and $p_b \geq p_a$.⁷ Importantly, this result holds no matter the values of π , π' or δ . This means that location-specificity (increasing α) reduces the incentives to

⁵ We assume that individuals are risk-neutral, so that the expected value of the error term is also the expected utility. Risk aversion would add an additional cost to migration, since the idiosyncratic match will be certain in area A , but uncertain in area B .

⁶ That is, in area A , the half of the population with $e_a < 0$ and in area B the half of the population with $e_b < 0$ will migrate. Since $\pi = 1/2$, these population flows will be equal in size, and thus cancel each other out. Thus the assumption that $\pi = \pi' = 1/2$ is consistent with the result in this situation.

⁷ $p_b \geq p_a$ seems like a reasonable assumption here since much of this human capital is likely handed down from parents to children by “raising” them. This family time effectively lowers the shadow price of own-location human capital below that of the other location.

migrate because the acquisition of human capital specific to the individual's location increases the opportunity cost of migrating. This decreases (into the negative range) the cut-off value of e_a (the idiosyncratic taste for the home area) that makes individuals just indifferent between moving and staying. Migration out of each area still cancels out, but now less than half of each population migrates. Second-period location is now determined by idiosyncratic factors *and first-period residence*, even in the absence of traditional moving costs. In effect, the necessity of living in an exogenously determined location in the first period makes some acquisition of human capital specific to that region optimal. The acquisition of this knowledge makes the move to the other location relatively less attractive because the opportunity cost of moving to the dissimilar location is higher for everyone.

We obtain this result by assuming $\pi = \pi' = 1/2$ (and checking the assumption's consistency with the result). The general case (where $\pi \neq \pi' \neq 1/2$) is much more interesting, since it implies that regional wage differentials could be persistent. The proof relies on relationships not fully worked out, but which nonetheless must hold. The two relationships are the period-two population's relationship with the net flow of migrants from area A ($\pi'(flow)$) and the flow's response to the second-period population ($flow(\pi')$).

The functional form of $\pi'(flow)$ is easily derived, for the relationship is simply mathematical: $\pi'(flow) = \pi - flow$. The net flow's relationship to π' is more complex, because flow depends upon the decisions of agents in both areas:

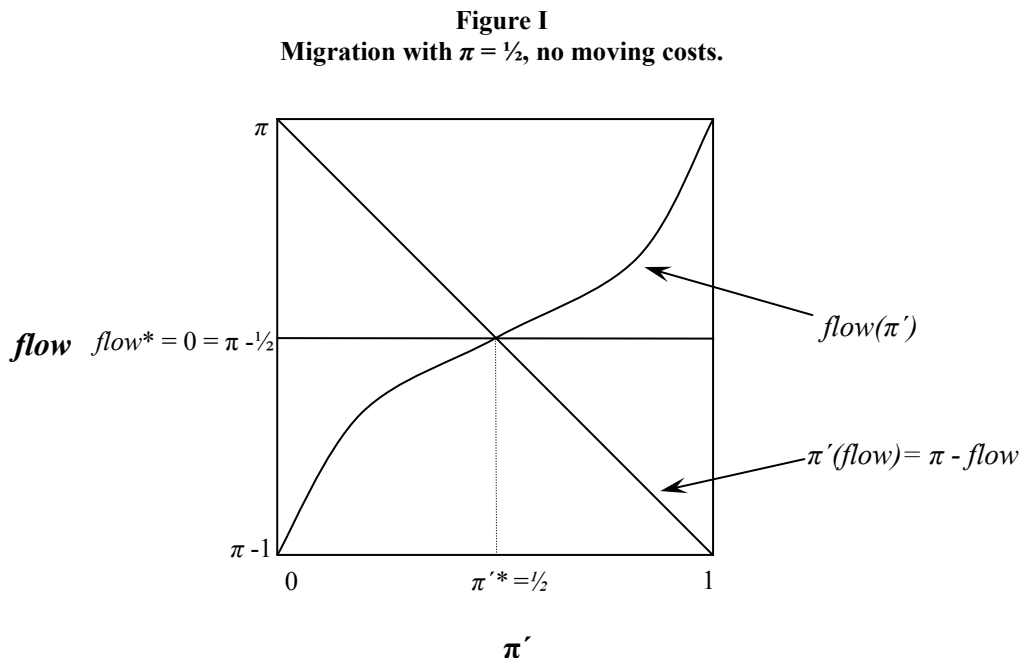
$$(7) \quad flow(\pi') = flow_{AB}(\pi') - flow_{BA}(\pi') = \pi pr(NW_S(\pi') < 0) - (1 - \pi) pr(NW_S(1 - \pi') < 0).$$

The gross flows out of A and B will be the proportion of the population who will find it optimal to migrate weighted by the region's first-period population share. The *Net Wage of Staying* (NW_S) functions are identical in each area, except that population share in area B is one minus

the population share in area A . The observed second-period population in and flow from area A will be $flow$ and π' such that:

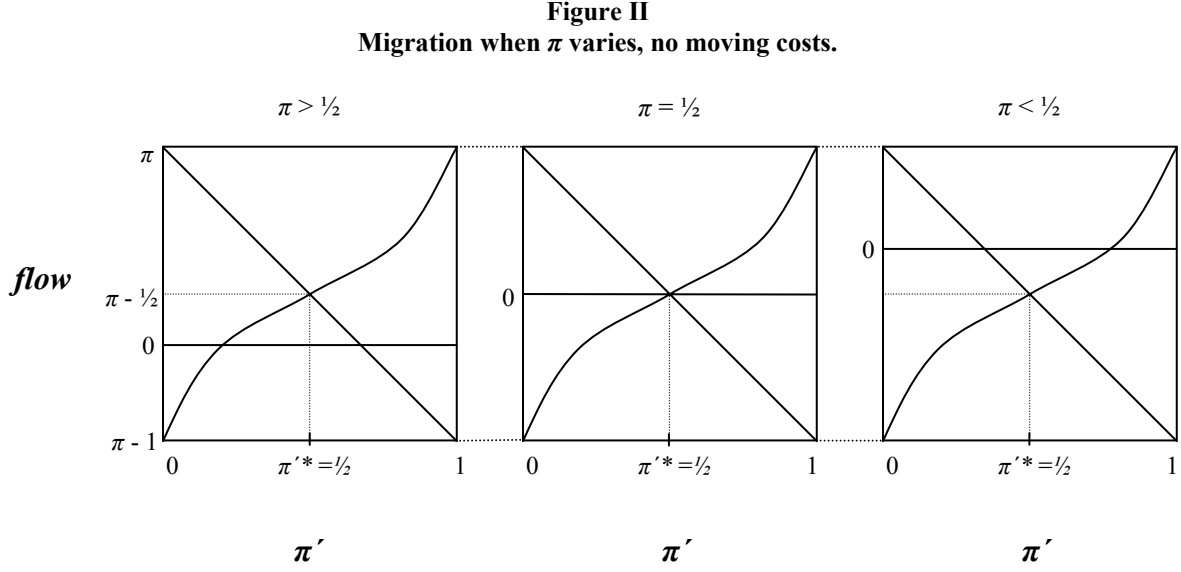
$$(8) \quad \pi'(flow^*) = flow(\pi'^*).$$

The case of $\pi = \pi' = 1/2$, which was shown analytically above, can thus be shown graphically as in Figure I. The curvature on the $flow(\pi')$ function ensures a stable equilibrium, and is a result of migration dissipating gains to migration as π' approaches $1/2$, thus discouraging further migration. The case shown above is a special case, when flows from each region exactly offset each other because $\pi = 1/2$.



If moving costs are zero, then migrants will arbitrage away any regional wage differentials. The no-moving-cost scenario is analogous in the model to $\alpha = \beta = 1/2$ and a zero expectation on the destination area's error term. The efficient migration result occurs whenever $\pi' = 1/2$. In this scenario, $flow(\pi' = 1/2) = \pi - 1/2$, no matter the value of π . This invariant outcome is

shown for three values of π in Figure II.



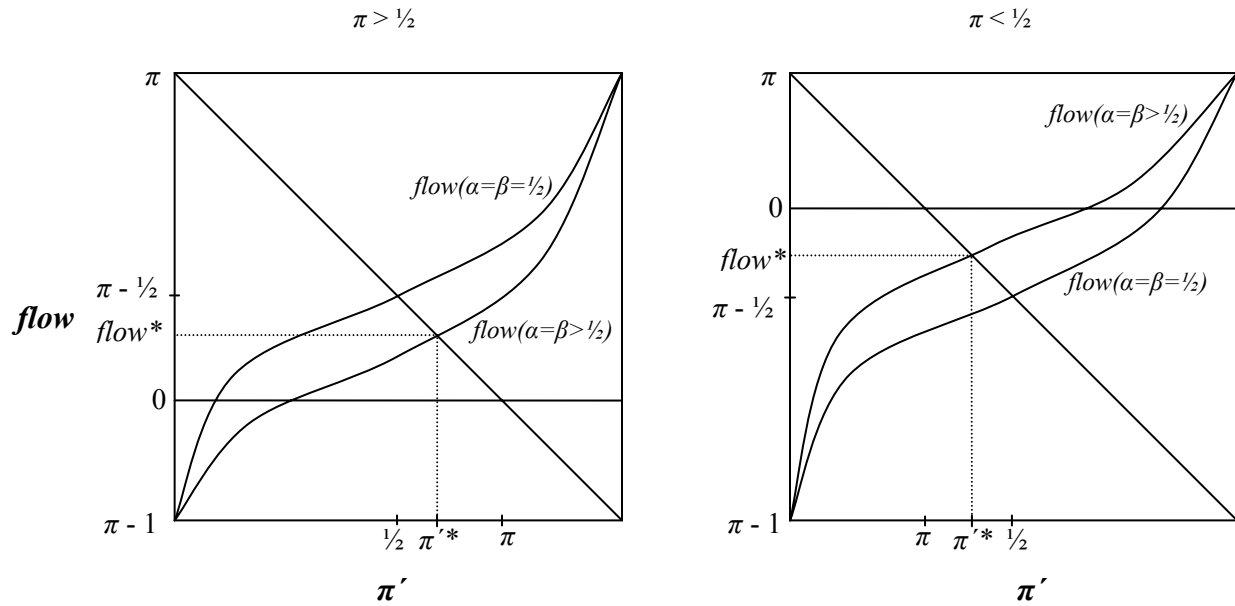
Inter-area wage equalization is achieved no matter what the initial condition as long as moving costs are zero ($\pi' = 1/2$ regardless of π). However, if moving costs are not zero, this result will not hold. If $\alpha = \beta > 1/2$, flows to and from each area will be affected, as shown in equation 9:

$$\begin{aligned}
 (9) \quad \frac{\partial flow(\pi')}{\partial(\alpha = \beta)} &= \frac{\partial(flow_{AB})}{\partial(\alpha = \beta)} - \frac{\partial(flow_{BA})}{\partial(\alpha = \beta)} \\
 &= \pi \frac{\partial(pr(NW_s < 0))}{\partial(\alpha = \beta)} - (1 - \pi) \frac{\partial(pr(NW_s < 0))}{\partial(\alpha = \beta)} \\
 &= (2\pi - 1) \frac{\partial pr(NW_s < 0)}{\partial NW_s^{av}} \frac{\partial NW_s^{av}}{\partial(\alpha = \beta)} \\
 \frac{\partial flow(\pi')}{\partial(\alpha = \beta)} &\left\{ \begin{array}{l} > 0 \Leftrightarrow \pi < 1/2 \\ = 0 \Leftrightarrow \pi = 1/2 \\ < 0 \Leftrightarrow \pi > 1/2 \end{array} \right\},
 \end{aligned}$$

where NW_s^{av} is the average, or non-idiosyncratic portion of NW_s . Thus, net flow out of area A will not necessarily equalize second period wages. The $flow(\pi')$ function shifts, the equilibrium locus moves along the $\pi'(flow)$ line, the equilibrium amount of net migration decreases in magnitude from $\pi - 1/2$, and the equilibrium second-period population share moves away from $1/2$

and towards the initial value of π . This situation is shown graphically in Figure III. The function $flow(\alpha=\beta=1/2)$ represents the case with no moving costs, while the $flow(\alpha=\beta>1/2)$ function represents the case where location-specific human capital reduces migration flows and prevents second-period wage equalization (if the system started in disequilibrium).

Figure III
Migration when π varies, with moving costs.



Since the empirical treatment below does not depend upon direct measurement of local human capital, some discussion of what H_A and H_B represent is in order. In the above analysis, people are assumed to maximize *real* income, which takes into account quality of life, and efficiency of household production. The higher real wage for which individuals strive in the model could come about either through higher returns on human capital in the labor market or higher effectiveness of household-production-oriented human capital. In the above model, the negative relationship between each location's population and wage captures the effect of changing supply on the labor market.

On the other hand, the role played by specificity (α and β) in the labor market could come about because of geographical factors (location near a coast or raw material deposits), political factors (the location offering a more favorable regulatory atmosphere) or historical factors (the location historically being a center of some industry). While these factors are endogenous to a model of regional development, to the individual they are exogenous. If these factors influence human capital investment in the real-life equivalent of the first period with exogenous location, these geographic differences will have the effect described in the model. However, since young people can migrate before they begin working, such market-oriented factors will not be important. Market-oriented human capital only affects wage in the second period, so investment in such human capital will essentially be postponed until after migration: the effect through opportunity costs will not exist.

Specificity will play a much stronger role through the household sector. Children cannot choose where they live, so the real-life equivalent of the exogenous location period for individuals is likely to be their childhood. Human capital acquired during this period of forced residence will have the qualities of H_A and H_B in the model. The specificity of H_A and H_B will occur because a location's characteristics can make certain kinds of household production *more* productive. For example, higher returns on household-oriented capital could mean a better symphony orchestra for those who have invested heavily in an appreciation of classical music. It could mean proximity to good hunting areas for people who have invested heavily in outdoorsman skills. It could mean a collection of good microbreweries for those who have invested heavily in their liver, and appreciation of thick, pasty beers. These types of effects have traditionally been thought of as access amenities themselves, and thus enter the utility function

directly, however here they are reinterpreted as returns to investments.⁸

This model is thus similar to that proposed by Becker and Stigler [1977] and summarized in Becker [1996], where personal capital affects utility by making household production more efficient. The step taken here is in allowing area characteristics to affect the returns to such capital. In the model, there are only two kinds of human capital and the locations are characterized simply by an observable wage function in which the dissimilarity of the areas is captured by the level of specificity. In the real world there are innumerable kinds of human capital and locations are characterized by an array of objective and subjective attributes which affect returns on human capital. At aggregated levels such as the population the various investment types will more or less cancel each other out, leaving amenity variables apparently unimportant at the aggregate, but possibly all-important at the individual level.

The investments in this model have a strong exogenous factor because people can't choose their childhood residence. Exogenous determinates of amenity demand are used by Black *et al.* [2001] in modeling gay male residence patterns, but this model suggests a much broader set of exogenous demand shifters. While such considerations may not have significant effects on estimates of the demand for access to certain location characteristics (amenities), or on the effects of these characteristics on aggregate migration, they will help us better predict migration flows *between specific locations*. The model also extends the reservations raised in

⁸ Thus, amenities are assumed to affect utility only through the household production function, not directly through the utility function as in Diamond and Tolley [1982], Tolley [1974] or Rosen [1974]. The heterogeneity of people's investments could go a long way towards explaining why the geographic amenities perform so poorly in Graves and Regulska [1982], and why even the results for the climate variables in Graves [1979] are called into question by Greenwood and Hunt [1989], who find that employment variables out-perform amenity variables in explaining aggregate migration behavior: an unsurprising result given that employment is an amenity almost everyone appreciates, while scenic views, white Christmases and national parks are only valued by smaller subsets of the population.

Gyourko *et al.* [1999] about quality of life indexes up to this point: the implicit price of an amenity (as estimated using hedonic analysis) is set by the marginal migrant, but this price may not reflect the experiences of the majority of people, most of whom are very far from the margin because people are generally constrained to “consume” one location as a residence. The marginal market valuation of amenities is thus much less informative than the market valuation of a good of which consumers can choose to consume multiple units. The theoretical result also helps explain the results of Cheshire and Magrini [2004], who find that climate affects area growth within a country, but not across national (and linguistic) boundaries.

B. Extension to multiple regions.

Now, we extend the model to the case of more than two locations to show that the results from the two-location model carry through, and to help move the model towards the empirical treatment to follow. We allow for $L+1$ locations, consisting of the “home” location and L potential migratory destinations. We focus our attention on an individual considering a move from his home in the first period to another location. For such a person, they will not wish to migrate if it is the case that:

$$(10) \quad NW_s^l > 0 \quad \forall l,$$

where l indexes the L potential destinations. This is simply a generalization of the two-location case in the previous sections. If this condition does not hold, then the individual will migrate, choosing a new location i such that

$$(11) \quad NW_s^i < NW_s^j \quad \forall j \neq i.$$

Basically, given that a move is optimal, the individual will undertake the move which minimizes his opportunity cost of moving. Rewriting this condition:

$$(11)' \quad NW_s^i - NW_s^j < 0 \quad \forall j \neq i.$$

To highlight the effect played by location-specific human capital, we can decompose NW_S^i into three sub-components: the opportunity cost arising from market-wide, in-specific effects (M), the part arising from location-specific investments (S) and the part arising from idiosyncratic preferences (ε):

$$(12) \quad NW_S^i = [NW_S^i(\pi_i, \alpha = 1/2) - \varepsilon_i] + [(NW_S^i(\pi_i, \alpha) - \varepsilon_i) - (NW_S^i(\pi_i, \alpha = 1/2) - \varepsilon_i)] + \varepsilon_i$$

$$(13) \quad NW_S^i = M_i + S_i + \varepsilon_i$$

where $\varepsilon_i = \delta(e - e_i)$, the differences in the idiosyncratic matches of the home area and the potential destination location, i , as they appear in the NW_S^i condition of the previous sections. M_i and ε_i can be positive or negative, while S_i will be non-negative (and will be equal to zero when $\alpha=1/2$). The smaller NW_S^i (and each of its components), the more attractive it is as a destination.

Now plugging equation (13) into the moving choice condition we can decompose this condition into the three component parts:

$$(14) \quad NW_S^i - NW_S^j = [M_i + S_i + \varepsilon_i] - [M_j + S_j + \varepsilon_j] = [M_i - M_j] + [S_i - S_j] + [\varepsilon_i - \varepsilon_j].$$

Equation (14) can be interpreted as the attractiveness of area j relative to area i , in that if this quantity is positive, it means that area j will be more attractive to the individual than area i . Equation (14) states that this relative attractiveness will be determined by the difference in market wages and prices (the difference of the M), the extent to which investments specific to the home area have decreased the real wage in that area (the difference of the S) and the difference in the idiosyncratic match. Under the assumptions of the previous sub-sections, this last term will be normally distributed with a zero mean and a variance of $2\delta\sigma_\varepsilon^2$. It is important to remember that, because of the construction of the model, a person has an unusually strong

attraction to an area if the ε term is *negative*. Also keep in mind that individuals migrate to the location minimizing equation (14).

Now, in the two-location case, location-specificity was essentially a single parameter. The divergence of the location-specificity from $\frac{1}{2}$ represented the difference between the two locations: highly specific returns on investments were a result of the two areas differing greatly. In a model with many locations, this parameterization is no longer sufficient because there is no reason to believe that investments will exhibit the same level of specificity between two areas as they do between any other pair of locations.

Therefore, from the perspective of a potential migrant starting at the $L+1^{\text{st}}$ “home” location, the returns to certain types of human capital will likely be quite similar in locations that are similar to the home location, but these returns could be quite different in areas that are extremely different from the home location. For a potential migrant, then, each potential destination will be characterized by a different level of specificity (α_i), representing both how similar the receiving area is to the originating “home” area and how useful their childhood investments in human capital will be in the potential receiving area. Because α_i varies across areas, the S_i term will vary across areas as well, so the migration choice decision in equation (x+1)’ and (x+4) will not reduce to a simple comparison of market conditions and the idiosyncratic component.

The central result of the previous sections is represented in the current context as follows:

$$(15) \quad \frac{\partial S_i}{\partial \alpha_i} > 0.$$

If we represent the dissimilarity of an area from the home area with the variable d_i , the discussion above implies that α_i will be increasing in d_i . Thus the affect of dissimilarity on the

attractiveness of an area relative to some other area is easily derived:

$$\begin{aligned}
 (16) \quad \frac{\partial(NW_S^j - NW_S^i)}{\partial d_i} &= \frac{\partial NW_S^j}{\partial d_i} - \frac{\partial NW_S^i}{\partial d_i} = -\frac{\partial NW_S^i}{\partial d_i} \\
 &= -\left(\frac{\partial M_i}{\partial d_i} + \frac{\partial S_i}{\partial d_i} + \frac{\partial \varepsilon_i}{\partial d_i}\right) = -\frac{\partial S_i}{\partial d_i} \\
 &= -\frac{\partial S_i}{\partial \alpha_i} \frac{\partial \alpha_i}{\partial d_i} < 0.
 \end{aligned}$$

Note that the area in question (area i) enters negatively into the equation because NW_S^i is the opportunity cost of moving from home to i , so an increase in NW_S^i would represent the area becoming less attractive, not more attractive. If area j were the originating home area, this result is exactly parallel to the one derived in the two-location model.

However, what this equation shows is that when the model is extended to multiple locations, the central result holds: migrants will be less attracted to areas that are very dissimilar to the area in which they have grown up and more attracted to areas that are similar to those areas. The implication for people's behavior is that they will have greater valuation of (and thus demand for) amenity bundles similar to the ones to which they have had prior exposure: people will prefer to move to areas similar to their home towns, *ceteris paribus*.

One danger of the presentation is an over-deterministic interpretation. For instance, if we assume equal populations in each area, then the M_i terms will cancel out, and all that is left in the relative attractiveness equation is the location-specific investment portion (the difference in S) and the idiosyncratic portion. The focus on in the discussion has been on the S terms. The result that increasing dissimilarity reduces migration does not preclude people from moving from very dissimilar areas, however. Dissimilar areas may be migration destinations if it were the case that the idiosyncratic tastes for two areas will be strongly correlated if they are similar, and less

strongly correlated if they are more dissimilar. After some cut-off level of dissimilarity, the correlation would drop to zero. In this case, migrants dissatisfied with their taste for home face a trade-off between a chance at a better match in a very dissimilar location and the loss of returns on their location-specific investments. The distribution of these random error components of real wage and people's beliefs about the correlation of these error components across areas will determine the proportion of people undertaking moves to dissimilar locales, but the systematic part of the real wage will make these flows smaller than they otherwise would be if returns to human capital were not location specific.

III. Empirical Strategy.

The above model offers an alternative interpretation of how amenities work. Instead of taking amenities as public goods that enter the utility function directly, they are here thought of as only increasing utility through their effect on household production. All amenities, in effect, are production amenities.

The difference in interpretation allows a test. If amenities enter the utility function directly, as any consumer good does, then they should have income elasticities, just like any good. This income elasticity derives from the work of Rosen [1974] and Tolley [1974]. High-income families or individuals are able to purchase higher levels of amenities by locating in an area with high amenity levels but lower pay. If amenities enter the utility function directly, then richer families should be observed demanding more of them, assuming they are normal goods.

On the other hand, to the extent that amenities are used in household production, then most of the added "income" that they create will not be observed by the econometrician. Investments in location-specific human capital will increase utility (by making household production more efficient) but not increase take-home pay. Thus, if amenities are simply

production-related, and not valued *per se*, then there is no reason to expect that richer families should demand more of them. Instead, prior exposure – which has led to increased ability to take advantage of the amenity – will be the primary predictor of the demand for the amenity.

The regressions that are run are of the form:

$$(17) \quad A_T = \gamma_0 + \gamma_1 \text{income} + \gamma_2 A_0 + \gamma_3 X + \varepsilon_1,$$

where A_T is the level of amenity demand at the terminal date (2000, in our data set), A_0 is the level of amenity experienced at the original location (county of residence at age 14), and X is a vector of individual characteristics. Because amenities are theorized to affect wages through capitalization, we instrument for income using several background variables available in the National Longitudinal Survey of Youth, 1979 cohort. These include AFQT scores, occupational dummies for the individual, their spouse and their parents, education levels for the individual, spouse and the parents, race/AFQT and race/education interactions, and some information about the kind of household in which the individual grew up. Summary statistics for these variables are available in Krupka [2004]. Individual characteristics that affect amenity demand (X) in equation 17 are education, the number of children and marital status.

Tables I through VI list the amenity variables used in the analysis along with the average year 2000 values experienced by the sample of NLSY79 respondents with valid geographic data. The tables are broken into six categories of amenities in order of approximate mutability: natural or immutable variables, social or economic outcomes, land-use patterns, retail leisure opportunities and cultural leisure opportunities, and the religious characteristics of the county.

The first table presents natural characteristics generously provided by MacGranahan. Policy-makers are not able to affect these county characteristics. They are all well-worn variables in the amenity literature. The final combined score is a combination of the other

variables composed by MacGranahan [1999] based on the standard assumptions. The model nuances our understanding of how these characteristics affect migration by taking into account the characteristics of the origin location of each respondent. The hypothesis is that hot Julys aren't as unattractive to people who are "used" to them, *etc.*

Table I
County Characteristics used in the Analysis: Natural/Immutable Characteristics.

| Variable | Mean | StDev | Panel? |
|---------------------------|---------|--------|--------|
| Avg. January Temp. | 37.677 | 12.694 | N/A |
| Avg. January Hours Sun | 156.324 | 39.790 | N/A |
| Avg. July Temp. | 76.223 | 5.424 | N/A |
| Avg. July Humidity | 59.771 | 14.196 | N/A |
| Topography Code | 8.579 | 7.087 | N/A |
| Percent Water | 10.390 | 15.652 | N/A |
| ln(Percent Water) | 5.726 | 1.743 | N/A |
| Combined Score (of above) | 1.215 | 3.117 | N/A |

Note: mean and standard deviations are for the NLSY sample in 2000, not for the population of U.S. counties. The coding strategy for the topography variable is that it is increasing in "mountain-ness." An exact description of the meaning of each of the possible 21 values this variable takes is available at: <http://www.ers.usda.gov/Data/NaturalAmenities/natamenf.txt>.

Most of the other variables are not as well studied in the context of people's migration decisions. This is an interesting gap in the literature, since they tend to be more malleable, and of more policy interest. Table II presents the county characteristics that are social or economic outcomes. They are culled from the NLSY79 Geocode files and the data provided by MacGranahan. These characteristics will only change very slowly, and only with immense and persistent government intervention.

Several different measures of a county's urbanicity are available. While the difference between urban and rural areas is easily observable, researchers have not known whether to consider the urban nature of an area an amenity (lower cost of cultural goods) or a disamenity (congestion, crime *etc.*). This paper offers a more intuitive way of looking at the distinction, showing people prefer to go where they have learned well how to live. People also care about

the kinds of neighbors they keep. This has never been considered an amenity in empirical researcher⁹ looking at migration for the same reason as metropolitan status: there is no reason why the kinds of neighbors one has should be an amenity or a disamenity. The model in this paper suggests that people can get used to certain kinds of neighborhoods: black, white, or racially diverse.

Table II
Amenity variables used in analysis: Social/economic outcomes.

| Variable | Mean | StDev | Panel? |
|------------------------------------|----------|----------|--------|
| Urban Dummy | 0.767 | 0.423 | Yes |
| Urban Influence (decreasing) | 2.279 | 2.031 | No |
| Rural/Urban Continuum (decreasing) | 1.917 | 2.328 | No |
| Population Density | 1807.313 | 5225.238 | Yes |
| Crime Rate per 100,000 | 5941.497 | 2932.850 | Yes |
| Local Unemployment | 4.501 | 2.510 | Yes |
| Percent College educated | 19.686 | 7.733 | Yes |
| percent Black | 0.154 | 0.150 | Yes |
| percent White | 0.669 | 0.216 | Yes |
| Racial Diversity index | 0.567 | 0.212 | Yes |

Note: Coding for Urban Influence and Rural/Urban Codes can be found at <http://www.ers.usda.gov/Data/NaturalAmenities/natamenf.txt>. Crime rate is the 1991 crime rate of the year-2000 county of residence.

In addition, the disamenities of unemployment and crime are included. It is possible that people develop coping strategies in high unemployment or high crime areas. Labor migration will tend to mute the effects predicted by the model in the case of unemployment, while Tiebout sorting within counties will make the county-level measure of crime rate only a proxy of the crime experienced by any individual. Nevertheless, these variables are run with the rest to see if people sort in the way predicted by the model.

A third type of variable examined below is more changeable: land-use patterns. While

⁹ An exception is Noonan (2002).

how land is used is the result of it being turned to its highest-value use, government intervention in land markets through direct acquisition, zoning and targeted subsidies allow policy-makers to affect land-use patterns in their jurisdiction. Table III shows the land-use variables generated from data available on the USGS website.¹⁰

Table III
Amenity variables used in analysis: Land-use patterns.

| Variable | Mean | StDev | Panel? |
|---------------------------|-------|-------|--------|
| Percent Forests | 0.275 | 0.272 | No |
| Percent Wetlands | 0.046 | 0.096 | No |
| Percent Agricultural Uses | 0.260 | 0.266 | No |
| Percent Urban Uses | 0.179 | 0.212 | No |
| Percent Ugly Stuff | 0.009 | 0.020 | No |
| Percent Natural State | 0.443 | 0.284 | No |
| Percent Open | 0.383 | 0.304 | No |

*Note: these variables are sums of (unreported) raw variables as follows: **Percent Forest**: sum of three forest types; **Percent Wetland**: sum of two wetland types; **Percent Agricultural**: sum of Orchards/Vineyards, Pasture/Hay, Row Crops, Small Grains and Fallow; **Percent Urban Uses**: sum of Urban grass, Low- and High-intensity Residential and Commercial/Industrial/Transport; **Percent Ugly Stuff**: sum of Bare Rock, Quarries/Mines and Transitional; **Percent Natural State**: sum of forest, wetlands, Shrublands, Grasslands, and snow/ice; **Percent Open**: sum of Shrublands, Grasslands, Bare Rock, Urban Grass and Agricultural (less Orchards/Vineyards).*

The manner in which the land is used determines what is on the land, and thus what residents see in their daily life. While people are often assumed to like trees, beauty is truly in the eye of the beholder. The model presented in this paper lets people differ systematically in their taste for scenery, based on what they came to enjoy as youths. These data are unfortunately not panel: 2000 values are applied to age-14 counties. For some variables this is a limitation. Detailed land-use data is not available for previous years, however, so the 2000 values will have to be taken as proxies for the late-70's values in the hope that they have not changed drastically.

¹⁰ Special thanks are due to Jessica Brown of the United States Geological Survey and Douglas Noonan for helping with data processing. These seven variables were generated by summing subsets of twenty more specific variables. Descriptive statistics for these variables are available in Krupka [2004].

The fourth and fifth tables present data on private goods generously provided by Terry Clark.¹¹ While all of the objects represented in these variables are free to charge admission, in the absence of perfect price-discrimination, the consumer surplus they provide to their customers is a good that is not captured in the prices charged, so access to these enterprises will be desirable, and non-priced. Access to these retail outlets are thus public goods. They are broken into two groups (retail and cultural) based on the judgment of Clark [2003]. Tables IV and V present retail-oriented leisure opportunities and cultural amenities, respectively.

Table IV
Amenity variables used in analysis: Retail-oriented amenities.

| Variable | Mean | StDev | Panel? |
|-------------------------------|------|-------|--------|
| No. Starbucks Stores | 6.25 | 16.48 | No |
| Starbucks per Million | 3.47 | 7.24 | No |
| No. Brewpubs | 3.63 | 5.27 | No |
| Brewpubs per Million | 5.46 | 9.76 | No |
| No. Juicebars | 5.41 | 19.34 | No |
| Juicebars per Million | 2.32 | 3.87 | No |
| No. Whole Foods Stores | 0.61 | 1.97 | No |
| Whole Foods per Million | 0.27 | 1.33 | No |
| Sum of above Per Cap Z-scores | .00 | 2.35 | No |
| No. Professional Sports Teams | 1.80 | 2.60 | Yes |
| No. Bike Events | 4.35 | 7.67 | No |
| Teams plus Bike Events | 6.15 | 9.24 | No |

In contrast to Clark, the statistical treatment here will also examine the effects of the *per capita* levels of the retail amenities. There are two reasons why *per capita* levels may be better measures of actual amenity levels than absolute levels. First, crowding might drive down the consumer surplus of using an outlet and make its existence less of an amenity. On the other hand, if you assume that the owners or operators of the retail establishments are profit-

¹¹ A more extensive description of the data can be found in Clark [2003].

Table V
Amenity variables used in analysis: Cultural amenities.

maximizing business people, then the *per capita* quantity of stores in an area is a loose measure of the demand for such retail outlets by the average individual in the area. Thus, the presence of retail outlets signals the kind of neighbors one would have in an area.

Table V
Amenity variables used in analysis: Cultural amenities.

| Variable | Mean | StDev | Panel? |
|------------------------------|-------|-------|--------|
| Number of Rare Book Stores | 1.564 | 3.546 | No |
| Number of Research Libraries | 1.061 | 1.782 | No |
| Number of Opera Companies | 0.973 | 2.187 | No |
| Number of Museums | 1.448 | 2.060 | No |
| Sum of Cultural Amenities | 5.046 | 7.996 | No |

Per capita figures were not computed for the cultural amenities, because crowding was not thought to be as much of a problem and because larger fixed costs were thought to prevent these institutions from reflecting accurately the *current* demand.

As is the case for the land-use data, these are not panel data. They represent the world as it was circa 2000. Because of higher fixed costs, this may be less of a problem for the cultural amenities, but the problem still remains. As with the land-use data, we must hope that the 2000 levels are reasonable proxies for the age 14 levels experienced by our sample of NLSY79 respondents. We must take the 2000 levels as indicators only of some unobserved “amenity-richness” which is persistent.

Table VI presents summary statistics for the final type of county characteristic this paper examines: the religious makeup and opportunities available. The religious makeup of an area can be considered an amenity for several reasons. First, and most obviously, most religions require several adherents to be observed. But religious institutions do not merely provide worship opportunities (which are, in any case, only attractive to adherents). The religious

character of an area affects all residents through religious observances, festivals and the character or behavior of the population. It may also be the case that areas with particularly rich mixes of religious opportunities are attractive in their own right. In all these ways, religion is or creates amenities for which people can gain tastes through childhood habituation or deliberate investment. The data are derived from data collected by the American Religion Data Archive.

Table VI
Amenity Variables Used in Analysis: Religious Characteristics.

| Variable | Mean | StDev | Panel? |
|---------------------------|--------|--------|--------|
| Religious Diversity Index | .348 | .140 | Yes |
| Religions present | 45.954 | 22.010 | Yes |
| % unaffiliated | .498 | .130 | Yes |
| % Catholic | .215 | .153 | Yes |
| % Jewish | .020 | .033 | Yes |

Note: Religious diversity index is the sum of the squared proportions of the 40 different "religious types" defined by the author. "Religions present" is the number of the 256 possible religions that maintain congregations in the county.

We look first at three general measures of religious activity. The first is a religious diversity index composed by summing the squared proportions of religious adherents across 40 different religion *types*. The second is the number of the 256 possible different religions that maintain congregations in the county. Finally, the proportion of the county population that is not affiliated with any church is taken as a measure of the prevalence of more secularly-oriented people in the county. The last two variables, *percent Roman Catholic* and *percent Jewish*, are self explanatory. Each of these measures is taken for the 2000 county of residence, and the 1980 levels of the same variables are applied to the county of residence at age 14.

However, simply running the regression as presented in the paper thus far will present upward biased coefficients on the effects of prior exposure if any kind of moving costs keep people from leaving their original area. Although such individuals are staying in similar areas, just as the model predicts, they may be doing so for reasons unrelated to the central dynamic

advanced in the theoretical model, such as physical moving costs or loss of returns on very local social capital as described in Putnam (2000) and Glaeser *et al.* (2002). To prevent such moving costs from contaminating our results, we restrict our sample only to people who have moved at least 500 kilometers from their county of residence at age 14 and who resided for at least five panels¹² in a county other than the one in which they lived at age 14, or who were residing at a different county in the 2000 wave.¹³

IV. Core Results.

The NLSY79 includes 8033 individuals who were interviewed both in 1979 and 2000.¹⁴ Aged 14-22 in 1979, these “youths” were between 36 and 44 in 2000. By this age most individuals have “settled down,” so we can take their location in the 19th wave of this panel to represent their revealed preference, given everything else, for amenities.

The 2SLS regressions were run with all 67 environmental variables.¹⁵ To recap the predictions of the two models briefly: Standard amenity theory posits that amenities enter the utility function directly. Thus, standard theory predicts that amenities should have income elasticities just like any other good that enters the utility function. The theory advanced here, in

¹² Each wave is one year up until 1994, at which time the “youths” are interviewed only every other year.

¹³ By looking only at individuals who have gone through the trouble of undertaking long-distance moves, we rule out the possibility that simple moving costs are driving the results. By focusing on individuals who remained away for at least five waves, we purge out people who left home for college, but returned home immediately after college without ever undertaking the high-cost migration we are assuming is concurrent with the 500km move. These people will also have had a chance to build strong social contacts elsewhere. A treatment using a Heckman-two-step procedure by correcting for the sample selection of non-movers proved unstable, so this simpler sample restriction method is used instead.

¹⁴ After the sample restrictions, about 1,660 observations remain. This figure varies slightly from regression to regression. Full sample sizes are available from the author on request.

¹⁵ Ideally, we would allow for cross-equation correlation of the error terms by performing seemingly unrelated regressions. Unfortunately, this was not feasible in Stata, so these regressions were somewhat inefficient.

contrast, posits that amenities increase utility only through their effect on household production, and investments in location-specific human capital. In the absence of capital constraints, income effects should be insignificantly different from zero, while previous exposure to the amenity will be strongly and positively related to the amount of the amenity demanded because of investments made during the assumed period of forced, exogenous residence.

The rest of the section is split into sections focusing on the five variable types above. The results are extremely favorable: of the 67 exposure variables, 64 (two-tailed) or 65 (one-tailed) are significant at the .05 level, and the standardized effects of the exposure variables are on average seven times the standardized effects of the next strongest variable. The predictive powers of the models are low, with r^2 s ranging between .02 and .1, which shows that the considerations of this model (and of amenity demand in general) could be only marginal considerations of long-distance migrants: larger forces are at work, sending people on long-distance moves, and these forces add a lot of noise to the relationship.

A: Natural/Immutable Characteristics.

Table VII presents the results for the county characteristics that cannot change with time. The table represents eight regressions: each row represents a different model. The first row, for instance, represents the effects of each of the five independent variables on the year-2000 county average January temperature. In this case, the “Amen” column represents the association between age-14 county January temperature and year-2000 county January temperature. In the second row, the dependent variable is year-2000 average hours of sun in January and the “Amen” column represents age-14 average hours of sun, and so on. The t-statistics are listed under the effects in a slightly smaller font. So the effects can be compared, the effects shown are the standardized effects: the change in the dependent variable associated with a *one standard*

deviation change in each column's independent variable.

Table VII
Results: Natural/immutable characteristics.

| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
|------------------------|-------|------|-------|-------|---------|
| Avg. January Temp. | 0.89 | 3.84 | -0.33 | -1.07 | 0.06 |
| t-statistic | 0.88 | 8.29 | -0.75 | -2.53 | 0.13 |
| Avg. January Hours Sun | 7.84 | 9.67 | -1.27 | -2.96 | -3.05 |
| t-statistic | 1.88 | 6.45 | -0.77 | -2.06 | -1.35 |
| Avg. July Temp. | 1.17 | 1.99 | -0.71 | 0.03 | -0.58 |
| t-statistic | 2.46 | 7.57 | -3.58 | 0.15 | -2.41 |
| Avg. July Humidity | -0.64 | 6.26 | 0.30 | 0.08 | 0.87 |
| t-statistic | -0.42 | 9.73 | 0.51 | 0.17 | 1.10 |
| Topography Code | -0.70 | 1.85 | 0.59 | -0.19 | 0.11 |
| t-statistic | -1.12 | 6.21 | 2.35 | -0.84 | 0.40 |
| Percent Water | -0.49 | 1.60 | 0.71 | -0.75 | 0.24 |
| t-statistic | -0.42 | 2.46 | 1.23 | -1.45 | 0.40 |
| ln(Percent Water) | -0.14 | 0.31 | 0.12 | -0.09 | 0.10 |
| t-statistic | -0.84 | 6.43 | 1.67 | -1.39 | 1.07 |
| Combined Score | -0.08 | 0.85 | 0.22 | -0.36 | 0.10 |
| t-statistic | -0.36 | 9.10 | 2.27 | -3.82 | 0.91 |

Note: effects are the standardized effects: the coefficient times the standard deviation of the independent variable. They represent the change in the dependent variable associated with a one standard deviation change in each column's independent variable. The dependent variable is the year 2000 value of the variable listed in the "dependent variable" column. The amenity referred to in the "Amen" column is the value of each row's county characteristic in the county of residence at age 14.

The results are very favorable. In every case, the exposure variable (shown in the "Amen" column) is highly significant. The standardized effects of the exposure variables are also larger than those of any other variable in every case. In the case of July humidity, the standardized effects of exposure are almost ten times the next strongest variable (income). Prior exposure to humidity is also the only variable even close to significance in predicting final demand for low-humidity areas. This makes intuitive sense, since the rest of the county characteristics can impose some direct costs (through heating, cooling or transportation), while humidity is purely a matter of preference.

B: Social/Economic Outcomes.

Table VIII presents the results for the social and economic outcomes. These county characteristics are more malleable than climate or topography, but are still extremely difficult for policy makers to affect. Again, the results are favorable. In every case except population density, the exposure variable is significant. The effects of prior exposure are not as dominant as in Table VII: it is strongest only for the racial characteristics, and is usually second largest.

The way in which the exposure variable measures up to the other independent variables is instructive. Prior exposure is weak in the population density regression: only income's effect is weaker. This makes sense since population density varies wildly within a county: county-level population density is a poor proxy for the density experienced by the youth, so the coefficient is biased downwards. Prior exposure also has small effects in the other urban indicators, presumably for the same reason. The fact that prior exposure's standardized effect is smaller than those of family size for crime; education for *percent* college educated; and income for unemployment also makes sense since these are attributes particularly related to those variables.

Table VIII
Results: Social/economic outcomes.

| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
|------------------------|---------|--------|--------|---------|---------|
| Urban Dummy | 0.07 | 0.03 | 0.04 | -0.01 | -0.02 |
| t-statistic | 1.95 | 2.34 | 2.87 | -1.00 | -1.11 |
| Urban Influence | -0.41 | 0.33 | -0.20 | 0.06 | 0.14 |
| t-statistic | -2.39 | 4.01 | -3.35 | 0.86 | 1.70 |
| Rur/Urb. Continuum | -0.39 | 0.36 | -0.33 | 0.08 | 0.15 |
| t-statistic | -2.09 | 4.34 | -4.94 | 1.03 | 1.70 |
| Population Density | -151.13 | 177.05 | 549.11 | -261.22 | -369.86 |
| t-statistic | -0.54 | 1.39 | 3.96 | -3.06 | -2.10 |
| Crimes/100,000 | 138.71 | 236.33 | 117.02 | -298.78 | -125.84 |
| t-statistic | 0.55 | 2.33 | 1.12 | -2.71 | -1.07 |
| Local Unemployment | -0.40 | 0.23 | -0.17 | 0.19 | 0.05 |
| t-statistic | -2.76 | 3.97 | -3.03 | 2.87 | 0.80 |
| % College educated | 0.93 | 1.67 | 2.77 | -0.45 | -0.40 |
| t-statistic | 1.28 | 6.04 | 9.31 | -2.05 | -1.34 |
| percent Black | -0.01 | 0.04 | 0.00 | 0.00 | 0.00 |
| t-statistic | -1.23 | 6.56 | 0.34 | -0.89 | -0.91 |
| percent White | 0.00 | 0.06 | -0.02 | 0.01 | 0.01 |
| t-statistic | 0.23 | 8.81 | -4.31 | 1.79 | 2.03 |
| Racial Diversity index | -0.01 | 0.06 | -0.03 | 0.01 | 0.01 |
| t-statistic | -0.38 | 8.08 | -4.57 | 2.01 | 1.88 |

C: Land-use Patterns.

Only the results for the combined land-use variables are reported here.¹⁶ These results are presented in Table IX, which shows that the results for these aggregate measures are quite strong. The exposure variables are highly significant in all seven regressions. In each regression, the standardized effect of the exposure variable is the largest by a large margin.

¹⁶ The results on the twenty raw land-use variables are also strong. The exposure variable is significant at the .05 level in nineteen of twenty regressions (two-tailed) and all twenty regressions (one-tailed). None of the other variables achieve significance more than six times. Exposure's standardized effects are the largest in seventeen of the twenty regressions, and is very close to the largest effect in the other three regressions (shrublands, low-intensity residential and quarries/mines). These results are available from the author.

Table IX
Results: Combined land-use patterns.

| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
|-----------------------|--------|-------|--------|--------|---------|
| Percent Forest | -0.038 | 0.043 | 0.000 | 0.015 | 0.012 |
| t-statistic | -1.48 | 4.05 | -0.01 | 1.69 | 0.94 |
| Percent Wetland | -0.006 | 0.021 | -0.005 | -0.007 | 0.005 |
| t-statistic | -0.63 | 4.77 | -1.51 | -2.29 | 1.13 |
| Percent Natural State | -0.004 | 0.067 | -0.021 | -0.006 | 0.004 |
| t-statistic | -0.16 | 5.99 | -2.13 | -0.65 | 0.31 |
| Percent Open | 0.042 | 0.075 | -0.026 | 0.009 | 0.001 |
| t-statistic | 1.33 | 6.37 | -2.18 | 0.85 | 0.05 |
| Percent Agricultural | 0.001 | 0.073 | -0.011 | 0.023 | 0.013 |
| t-statistic | 0.06 | 8.15 | -1.31 | 3.21 | 1.41 |
| Percent Urban Uses | 0.008 | 0.035 | 0.028 | -0.007 | -0.019 |
| t-statistic | 0.62 | 7.55 | 5.52 | -1.45 | -3.16 |
| Percent Ugly Stuff | 0.002 | 0.003 | -0.001 | 0.000 | -0.001 |
| t-statistic | 1.31 | 2.86 | -2.57 | -0.55 | -1.47 |

D: Retail-oriented Amenities.

The results for the retail opportunities data are presented in two parts: absolute and *per capita* results. The absolute results are presented in the first panel of Table X, while the *per capita* results are presented in the second panel.

Of the seven regressions represented in the top panel of Table X, the exposure variable is significant in all seven and exhibits the largest standardized effect in four of the seven. In the other three regressions (Starbucks, Brewpubs and Whole Foods stores), it exhibits the second largest standardized effect, and is close in magnitude to the largest standardized effect. The only other variable that is significant is education, which is significant in all seven models, and has the largest standardized effect in the three models in which the exposure variable does not.

The *per capita* effects reported in the bottom panel of Table X are weaker, but still strong. The exposure variable is significant in all but one regression (Whole Foods, where it is insignificantly *negative*). Prior exposure's standardized effects are largest in two cases, and

either second or third in two cases. Only in the case of Whole Foods is the effect substantively small compared to the other variables.¹⁷

Table X
Results: Retail-oriented Amenities.

| Absolute | | | | | |
|-------------------------|--------|--------|-------|--------|---------|
| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
| No. Starbucks Stores | -0.263 | 1.660 | 1.821 | -0.355 | -0.342 |
| t-statistic | -0.40 | 5.06 | 5.08 | -1.01 | -1.04 |
| No. Brewpubs | 0.498 | 0.655 | 0.827 | -0.323 | -0.215 |
| t-statistic | 1.24 | 2.48 | 4.55 | -1.53 | -1.00 |
| No. Juicebars | 0.500 | 1.953 | 0.928 | -0.313 | -0.342 |
| t-statistic | 0.69 | 14.40 | 2.37 | -0.78 | -0.83 |
| No. Whole Foods Stores | -0.016 | 0.136 | 0.193 | -0.032 | -0.007 |
| t-statistic | -0.18 | 4.87 | 4.61 | -0.67 | -0.17 |
| No. Prof. Sports Teams | 0.105 | 0.366 | 0.356 | -0.048 | -0.097 |
| t-statistic | 0.67 | 5.32 | 5.03 | -0.82 | -1.28 |
| No. Bike Events | 0.711 | 0.914 | 0.615 | -0.343 | -0.260 |
| t-statistic | 1.26 | 6.25 | 2.46 | -1.50 | -0.84 |
| Teams plus Bike Events | 0.938 | 1.291 | 0.962 | -0.407 | -0.348 |
| t-statistic | 1.48 | 7.44 | 3.43 | -1.61 | -1.05 |
| <i>Per Capita</i> | | | | | |
| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
| Starbucks per Million | -0.059 | 0.520 | 1.366 | -0.110 | -0.186 |
| t-statistic | -0.13 | 2.25 | 4.99 | -0.58 | -0.85 |
| Brewpubs per Million | 0.957 | 1.533 | 1.231 | -0.250 | -0.290 |
| t-statistic | 0.98 | 2.88 | 2.55 | -0.48 | -0.62 |
| Juicebars per Million | 0.873 | 0.932 | 0.299 | -0.367 | -0.333 |
| t-statistic | 2.43 | 3.50 | 1.90 | -2.60 | -1.87 |
| Whole Foods per Million | 0.169 | -0.015 | 0.091 | 0.012 | -0.032 |
| t-statistic | 0.78 | -0.50 | 0.83 | 0.17 | -0.85 |
| Sum of Per Cap Z-scores | 0.433 | 0.348 | 0.459 | -0.129 | -0.163 |
| t-statistic | 1.89 | 2.87 | 3.73 | -1.29 | -1.74 |

¹⁷ It is possible that these partial correlations are being driven by the omitted variables of urban status, as these retail outlets have good, profit-maximizing reasons to locate only in larger urbanized areas. This is also a possible explanation for several of the social/economic variables above, and for the cultural and religious variables below. (Thanks to Lowell Taylor for bringing up this point). To test for this possibility, models were run for 28 “urban” type variables controlling for urbanicity of each respondent’s residence. In most cases, neither the significance, nor the magnitude of the exposure effect were reduced by the inclusion of the various controls for urbanicity.

E: Cultural Amenities.

The results for the five regressions on cultural amenities are presented in Table XI. Again, the results are strong. The exposure variable is significant in all five models. Only education achieves significance in all five models, while family size and marital status are significant only one time each, and income is not significantly different from zero even once.

The standardized effects are strong relative to the other variables, except education. In all but one model (rare book stores), the standardized effects of education exceed those of prior exposure, sometimes quite comfortably. This is similar to the case for the absolute retail variables, and is particularly interesting since prior exposure has been modeled, in some sense, as a taste shifter. These results suggest that education – particularly, one might expect, college education – may act in a similar fashion: increasing demand for cultural amenities through the acquisition of specialized human capital. Although the results are only suggestive because people are not randomly assigned education levels (as they are assigned childhood residence), the intuitive appeal of such a mechanism is considerable.

Table XI
Results: Cultural amenities.

| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
|---------------------------|--------|-------|-------|--------|---------|
| No. Rare Book Stores | 0.067 | 0.352 | 0.314 | -0.068 | -0.075 |
| t-statistic | 0.45 | 6.24 | 4.21 | -0.81 | -0.93 |
| No. Research Libraries | 0.085 | 0.123 | 0.201 | -0.033 | -0.074 |
| t-statistic | 0.85 | 3.18 | 4.43 | -0.70 | -1.65 |
| No. Opera Companies | -0.006 | 0.193 | 0.229 | -0.048 | -0.085 |
| t-statistic | -0.05 | 2.81 | 5.27 | -1.07 | -1.58 |
| No. Museums | 0.022 | 0.133 | 0.211 | -0.118 | -0.183 |
| t-statistic | 0.13 | 2.10 | 3.27 | -2.04 | -1.78 |
| Sum of Cultural Amenities | 0.172 | 0.676 | 0.953 | -0.269 | -0.416 |
| t-statistic | 0.45 | 4.48 | 5.48 | -1.36 | -2.04 |

F. Religious Characteristics.

Finally, in Table XII, we turn to the results of the five religion regressions. The results are as favorable as those for the other county characteristics. In each case the exposure variables are highly significant, and the standardized effects are either largest or nearly largest (after education). Results not shown here show that most of this sorting is due to the approximately 85% of the sample who declared some religious affiliation. If we look only at the sample of about 250 people who declared no religious affiliation, both religious diversity variables become insignificant and the coefficients drop sharply. However, unaffiliated individuals exhibit stronger reactions to childhood exposure to areas with low affiliation rates than do religious individuals: the coefficient on the *percent* unaffiliated in the age-14 county of residence is over 50% greater than the same coefficient in a regression run on affiliated individuals.¹⁸

Table XII
Results: Religious Characteristics.

| Dependent Variable | Inc | Amen | Edu | Kids | Marital |
|---------------------|--------|-------|--------|--------|---------|
| Religious Diversity | 0.005 | 0.025 | 0.003 | 0.008 | 0.005 |
| t | 0.49 | 4.90 | 0.75 | 1.66 | -1.91 |
| Religions Present | 1.643 | 2.508 | 3.280 | -1.505 | 1.643 |
| t | 0.99 | 4.24 | 5.03 | -2.40 | -1.68 |
| % unaffiliated | 0.001 | 0.032 | -0.006 | -0.008 | 0.005 |
| t | 0.12 | 6.07 | -1.61 | -2.06 | 1.12 |
| % Catholic | -0.004 | 0.034 | 0.017 | 0.001 | -0.007 |
| t | -0.38 | 4.89 | 4.27 | 0.37 | -1.35 |
| % Jewish | 0.000 | 0.004 | 0.005 | -0.002 | -0.002 |
| t | -0.14 | 3.01 | 5.15 | -3.28 | -2.00 |

G. Conclusion to the Section.

In general the basic results are extremely favorable: in 67 models, the exposure variable

¹⁸ For *percent* Catholic and Jewish, additional regressions were run controlling for the individual's religious affiliation in a variety of ways, with no effect on the significance or strength of the exposure variables.

was positive and significant (as predicted in the model) in 64 cases. In 45 of the 67 models, the standardized effect of prior exposure is larger than all other variables, and it is second strongest in another sixteen models. On average, the magnitude of the standardized effects of prior exposure is seven times the magnitude of the standardized effects of the next most important variable. Some of the strength of these results is a result of return migration, however. When the sample is purged of the approximately 180 return migrants (people moving back to their home county), about forty percent of prior exposure's effect disappears, although on average prior exposure's standardized effects are still over three times those of the next most important variable.¹⁹

VII. Conclusion.

This paper has presented a model in which amenity valuation is contingent upon human capital investments and drawn out the implications for people's migration behavior. By showing that prior investments play a much more important role in determining a potential migrant's demand for amenities than income (or education, fecundity and marital status), this paper offers a new perspective on amenities, and a challenge to the traditional theory of amenities. Past models offered no explanation for variability in the values people place on public goods. By placing amenities in the utility function, only un-modeled taste shocks could account for such variation. The mechanism proposed here, by allowing people to invest in types of human capital that will increase their appreciation of amenities, explains how some of this variation can exist in a world where people are free to choose amenity bundles through migration.

¹⁹ About 60% of the total reported effects disappear when the 325 people moving back to within 100km of their original locations (including people moving back to their home counties) are excluded from the sample, this still leaves the standardized effect of prior exposure on average about 1.6 times that of the next strongest variables (marital status) on average and over twice that of education or income.

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NOT FOR PUBLICATION Appendix For Reviewers NOT FOR PUBLICATION

The difference in net income of moving and staying as a function of the parameters is arrived at by substituting the conditional optimal investment levels:

$$H_A^S = \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) / p_a$$

$$H_B^S = \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) / p_b.$$

and

$$H_A^M = \left(\frac{\alpha}{\pi} + \delta \frac{(1-\beta)}{(1-\pi')} \right) / p_a$$

$$H_B^M = \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\beta}{(1-\pi')} \right) / p_b.$$

into

$$NW_S^A = Net\ Income_S^A - Net\ Income_M^A =$$

$$\left[(1+\delta)W_A(H_A^S, H_B^S) - p_a H_A^S - p_b H_B^S + (1+\delta)e_a \right]$$

$$- \left[W_A(H_A^M, H_B^M) + \delta W_B(H_A^M, H_B^M) - p_a H_A^M - p_b H_B^M + e_a + \delta e_b \right]$$

The resulting equation is the Net Wage of Staying at location A, inclusive of the opportunity cost of moving is represented by:

$$\begin{aligned}
NW_S^A &= \left[\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) + \left[\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) \\
&- \left[\frac{\alpha}{\pi} + \delta \frac{(1-\beta)}{(1-\pi')} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{(1-\beta)}{(1-\pi')} \right) - \left[\frac{(1-\alpha)}{\pi} + \delta \frac{\beta}{(1-\pi')} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\beta}{(1-\pi')} \right) \\
&+ \delta \left[\frac{(1-\beta)}{(1-\pi')} - \frac{\alpha}{\pi'} \right] \ln p_a + \delta \left[\frac{\beta}{(1-\pi')} - \frac{(1-\alpha)}{\pi'} \right] \ln p_b \\
&+ \delta \left[\frac{1}{(1-\pi')} - \frac{1}{\pi'} \right] + \delta [e_a - e_b]
\end{aligned}$$

where the first three lines are the effects through increased income and the last line represents the difference in spending on capital (the first term) and the difference in the idiosyncratic match (the second term).

The steps taken to derive the result in the paper are: First, take the case where there is no cost to moving, no specificity of human capital and no incentive (on average) to migrate. This corresponds to the case where $\alpha = \beta = \pi = \pi' = 1/2$, and $\delta = 1$:

$$\begin{aligned}
NW_S^A &= \left[\frac{.5}{.5} + \frac{.5}{.5} \right] \ln \left(\frac{.5}{.5} + \frac{.5}{.5} \right) + \left[\frac{.5}{.5} + \frac{.5}{.5} \right] \ln \left(\frac{.5}{.5} + \frac{.5}{.5} \right) \\
&- \left[\frac{.5}{.5} + \frac{.5}{.5} \right] \ln \left(\frac{.5}{.5} + \frac{.5}{.5} \right) - \left[\frac{.5}{.5} + \frac{.5}{.5} \right] \ln \left(\frac{.5}{.5} + \frac{.5}{.5} \right) \\
&+ \left[\frac{.5}{.5} - \frac{.5}{.5} \right] \ln p_a + \left[\frac{.5}{.5} - \frac{.5}{.5} \right] \ln p_b \\
&+ \left[\frac{1}{.5} - \frac{1}{.5} \right] + [e_a - e_b] = e_a - e_b
\end{aligned}$$

Since e_b is only known in expectation and moving costs are assumed zero, the above equation reduces even further to:

$$E[NW_S^A] = e_a.$$

Since $e_a \sim N(0, \sigma)$, this condition implies that half the population at location A will want to migrate to B . This is also the case if there is a positive correlation r between e_a and e_b , since $E(e_b) = r e_a$, and $E[NW_S^A] = (1-r)e_a$, which is always of the same sign as e_a . However, the exact same condition holds at location B , namely:

$$E[NW_S^B] = e_b \sim N(0, \sigma),$$

which implies that half of the population at location B will want to migrate to location A . Since $\pi = 1/2$, the initial populations at A and B are the same, and so the migration flows from each to the other exactly offset. The exact equality of these two migration flows is why it is consistent for $\pi = \pi' = 1/2$. In this situation, half of both locations' populations migrate, and there is no correlation between initial and final residence (knowing where an individual lived for period one does not help you predict where they lived in period two).

Locational specificity of human capital will weaken this result. Allow $\alpha = \beta$ for simplicity (the specificity of human capital is symmetric), and substitute $\alpha = \beta$ into NW_S^A :

$$\begin{aligned} NW_{S\alpha}^A &= \left[\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) + \left[\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) \\ &- \left[\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')} \right) - \left[\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')} \right) \\ &+ \delta \left[\frac{(1-\alpha)}{(1-\pi')} - \frac{\alpha}{\pi'} \right] \ln p_a + \delta \left[\frac{\alpha}{(1-\pi')} - \frac{(1-\alpha)}{\pi'} \right] \ln p_b \\ &+ \delta \left[\frac{1}{(1-\pi')} - \frac{1}{\pi'} \right] + \delta [e_a - e_b] \end{aligned}$$

Differentiating with respect to α yields:

$$\begin{aligned} \frac{\partial NW_{S\alpha}^A}{\partial \alpha} &= \left[\frac{1}{\pi} + \frac{\delta}{\pi'} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) + \left[\frac{1}{\pi} + \frac{\delta}{\pi'} \right] \\ &+ \left[-\frac{1}{\pi} - \frac{\delta}{\pi'} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) + \left[-\frac{1}{\pi} - \frac{\delta}{\pi'} \right] \\ &- \left[\frac{1}{\pi} - \frac{\delta}{(1-\pi')} \right] \ln \left(\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')} \right) - \left[\frac{1}{\pi} - \frac{\delta}{(1-\pi')} \right] \\ &- \left[-\frac{1}{\pi} + \frac{\delta}{(1-\pi')} \right] \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')} \right) - \left[-\frac{1}{\pi} + \frac{\delta}{(1-\pi')} \right] \\ &+ \left[\frac{-\delta}{(1-\pi')} - \frac{\delta}{\pi'} \right] \ln p_a + \left[\frac{\delta}{(1-\pi')} + \frac{\delta}{\pi'} \right] \ln p_b \end{aligned}$$

Finally, simplifying results in the following equation:

$$\begin{aligned} \frac{\partial NW_{S\alpha}^A}{\partial \alpha} &= \left[\frac{1}{\pi} + \frac{\delta}{\pi'} \right] \left[\ln \left(\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} \right) - \ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \right) \right] \\ &+ \left[\frac{1}{\pi} - \frac{\delta}{(1-\pi')} \right] \left[\ln \left(\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')} \right) - \ln \left(\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')} \right) \right] \\ &+ \left[\frac{\delta}{(1-\pi')} + \frac{\delta}{\pi'} \right] (\ln p_b - \ln p_a). \end{aligned}$$

Assuming that the prices of capital investments are equal, the above effect is positive because:

$$\frac{\alpha}{\pi} + \delta \frac{\alpha}{\pi'} > \frac{(1-\alpha)}{\pi} + \delta \frac{(1-\alpha)}{\pi'} \quad \text{when} \quad \alpha > \frac{1}{2}, \quad \text{and} \quad \text{because} \quad \frac{1}{\pi} - \frac{\delta}{(1-\pi')} \quad \text{and}$$

$\ln\left(\frac{(1-\alpha)}{\pi} + \delta \frac{\alpha}{(1-\pi')}\right) - \ln\left(\frac{\alpha}{\pi} + \delta \frac{(1-\alpha)}{(1-\pi')}\right)$ will always have the same sign, and thus their product

will always be positive.¹ This is the case whatever are π and π' . But it was shown earlier in the

section that $NW_{S\alpha}^A(\alpha = \beta = \pi = \pi' = 1/2, \delta=1) = e_a$. If $\frac{\partial NW_{S\alpha}^A}{\partial \alpha} > 0$, then it must be the case that

$NW_{S\alpha}^A(\alpha = \beta > 1/2, \pi = \pi' = 1/2, \delta=1) > e_a$, which implies that less than half of the population at

location A will want to move. Since the exact same condition holds at location B , less than half

of B residents will choose to move. The moves will still exactly offset and $\pi = \pi' = 1/2$ will still

hold, but with smaller migration flows than in the case of complete generality. Since most

people who start out at a location stay, first-period location will now be a predictor of second-

period location, *i.e.* the two will be correlated.

¹ The equal price assumption is actually unnecessarily restrictive: one could also assume that local capital is less costly to acquire than foreign capital, which would strengthen the result.