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Empirical Evidence of the Stepping Stones Hypothesis

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Abstract

This paper explores hypotheses of hierarchical migration using data from the Alaskan Arctic. We focus on migration of Iñupiat people, who are indigenous to the region, and explore the role of income and subsistence harvests on migration. To test related hypotheses we use confidential micro-data from the US Census Bureau's 2000 Decennial Census of Population and Income and generate migration probabilities using a mixed multinomial and conditional logit model. Our findings are broadly consistent with Ravenstein's (1885) early hypothesis of step-wise migration; we find evidence of step-wise migration, both up and down an urban and rural hierarchy. We also find that where migrants choose to live is a function of place, personal, and household characteristics.

Keywords: Migration, Hierarchical Migration, Rural to Urban Migration, Arctic Alaska

JEL classifications: J61, O15, R23

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Introduction

Around the turn of the twentieth century E.G. Ravenstein (1885, 1889) published the "Laws of Migration," and demonstrated a key finding, that migration was often gradual, occurring in small geographic steps. Since Ravenstein researchers have refined this observation noting that migration frequently occurs through a hierarchy of places. That is, people don't simply move to communities in geographic proximity but move in steps along a place hierarchy from remote rural communities to progressively larger and more urban areas.[1] In the United States, for example, spatial structure models have been used to document these patterns between US states and metropolitan areas through the 1960's (Fik, et. al., 1992; Pellegrini and Fotheringham, 1999). Others identified a trend of 'counter-urbanization' replacing step-wise migration in the US beginning in the 1970's and noted that step-wise migration patterns are very sensitive to the migrant's age, education and other personal characteristics (Plane et. al., 2005). Here we build on existing work by exploring step-wise migration patterns from remote Arctic communities in the United States.

Much of the research on step-wise migration has been concentrated in high income countries, however, while empirical analysis has been restricted due to data limitations, step-wise migration and the role of distance is important in explaining migration patterns observed in low income countries (Greenwood, 1997; Lucas, 2001).[2] As these authors note, distance changes monetary, social, and psychic costs making shorter moves more attractive. In addition to these costs, distance changes opportunities for non-market food production. In many low income and transitional economies households in remote rural regions participate in a mix of formal labor market and informal small scale agriculture or hunting and gathering activities (i.e. subsistence).[3] Moving up the hierarchy to increasingly urban places may reduce opportunities for non-cash food sources or it may become more costly to participate in traditional food gathering activities. Hence the migrant accounts for this trade-off in determining when and where to move. Accounting for the effects of informal food sources on migration decisions has not, to our knowledge, been accounted for in a step-wise model of migration. We use data from other Arctic surveys to estimate the importance of non-cash food sources, i.e. subsistence, on the migration decision.

In summary, this paper describes the migration of labor from remote / periphery regions to urban areas controlling for differences in wages and subsistence hunting and gathering opportunities across a rural-urban hierarchy. While gravity models of migration have identified the importance of distance in migration flows, to our knowledge there have been few formal tests of the stepping stone hypothesis at the community level. In this paper we use confidential US

[1] Analogous patterns have been referred to as step-wise, hierarchical, stage, and chain migration in the literature (Conway, 1980).
[2] Early work identified step-wise patterns of migration in Columbia (Flinn and Converse, 1970) and Sierra Leone (Riddell and Harvey, 1972) but not in Nigeria (Afolayan, 1985). Pessino (1991) finds evidence for sequential migration in Peru and his work suggests that the human capital model of migration correctly predicts migration only if the timing and the region of migration are included in the model.
[3] In Alaska, "subsistence" refers to the plants, berries and eggs gathered and the fish, mammals and marine mammals harvested (e.g. salmon, caribou, moose, whale, and seal).

Census microdata for Arctic Alaska allowing us to differentiate between the effects of distance on migration and to measure the importance of formal versus informal opportunities of migration at the community level. In addition, given the findings of Plane et. al. (2005), we control for the effects of gender, education, and household characteristics on the migration decision using a mixed multinomial logit model.

The Study Region

Before describing Arctic migration patterns, it's important to identify the region and to highlight unique characteristics. We define "Arctic Alaska" as the three most northern census areas in the United States, the North Slope Borough, the Northwest Arctic Borough, and the Nome Census area of Alaska. This area makes up the historic Iñupiaq language grouping (Krauss, 1982) and the population is predominantly ethnic indigenous Iñupiat.[4] Alaska's Arctic region is a vast sparsely settled area; it is about 146,000 square miles with approximately 24,000 people living in 35 different places. About 47% of the population lives in one of three Regional Centers, Barrow, Kotzebue, or Nome, with populations of at least 3,000. The remainder of the population lives in one of 32 villages that range in size from about 100 (Kobuk) to 750 (Point Hope) (US Census, 2000).

Arctic Alaska lacks significant road connections and travel to and from communities within and from outside of the region is costly.[5] Movement to and from Regional Centers is typically by small aircraft and by boat, although snow machines and automobiles (via ice roads) are often used in winter months. Transport costs are roughly the same across villages in our study region.

Opportunities in both the formal and informal economy are important drivers of Arctic migration patterns. Like many remote rural economies, Alaska's Arctic economy is a mixed subsistence and cash economy. Cash earned in the labor markets is used to purchase goods and services, and over time cash has become a critical input to harvesting subsistence resources. Dog teams have been replaced with snow machines, and motorized boats and other modern hunting gear (e.g., ropes, rifles, and nets) are a necessity in fishing and marine mammal hunting.[6] While there is variation across regions, formal labor market opportunities are limited.[8] In 2003, Alaska's

[4] Overall, about 80% of the population in these three census areas self-identify as Alaska Native – in the 32 Arctic Villages about 90% of the population self-identifies as Alaska Native (US Census, 2000). The vast majority of Alaska Natives in this region are of Inupiat ancestry. Under Alaska law, "boroughs" are analogous to counties in other states, but also incorporate a unified school district. There is no organized borough government in the Nome Census Area.

[5] Relative to other remote regions (e.g. Arctic Canada), however, travel is significantly less costly (Berman, 2011).

[6] Harvesting and consuming subsistence resources, such as marine mammals, fish, caribou, and other land mammals, is an extremely important component of life in Arctic Alaska. In villages, about 70% of households reported participating in subsistence harvests while in regional centers about 60% of households participated (SLiCA, 2003). The state of Alaska has estimated that about 50% of total caloric needs are met through subsistence consumption in our study area (ADFG, 2000). Given its fundamental importance in daily life, subsistence considerations also play an important role in the decision to migrate.

[8] Formal labor market opportunities are influenced heavily by federal transfers and public sector hiring. In the late 1990's transfer payments made up about 28% of total personal income in the Northwest Arctic Borough, 25% in the Nome Census area, and 12% in the North Slope Borough (BEA, 2007). Direct public sector hiring accounts for more than 42 percent of employment in the combined Arctic region. The impact of public spending is even greater when the non-profit agency spending is included.

overall unemployment rate was 8%. In contrast, it was 13.8% in the North Slope Borough, 15.2% in the Nome region, and 20.1 % in the Northwest Arctic Borough.[9] High unemployment in the Arctic is reflected in per capita income and the incidence of poverty. In 2000, poverty rates in Nome and the Northwest Arctic Borough were almost three times the rate in Anchorage (Fried and Windisch-Cole, 2005).[10]

It has only been since the early 1900's or so since Iñupiat people abandoned temporary camps for more permanent settlements (Brown, 1969). Increasing modernization and the development of formal markets through the 20'th century contributed to growing regionalization and changes in Arctic migration patterns. Early studies described the process of large-scale village consolidation prior to statehood, as Iñupiat people moved to larger places up the hierarchy and regional population became increasingly concentrated in semi-urban Arctic Regional Centers (Alonso and Rust, 1970; Brown, 1969; Hippler, 1969). After 1970, others found a partial reversal of this trend as migration back to remote villages and between villages became more common (Howe, 2009; Kruse and Foster, 1986). Important gender differences in Arctic migration patterns have also been pointed out (Hamilton et. al., 1997).

For the most part, all existing studies on Arctic migration rely on community level population data from the Census. Consequently, explicitly controlling for the relative earnings and subsistence opportunities in the migration decision, as we do below, provides new insights on hierarchical migration patterns in the Arctic.

Data and Methods

Background analytical model

Migration in our model is motivated by a household production model of migration (Huskey, Berman, and Hill, 2004; Singh, Squire, and Strauss, 1986). Migration from place A to B occurs if individual utility in place B, net of migration costs, is greater than utility in other destinations,

$$U_{iA} < U_{iB} - C_{iB}$$

Utility in place j is a function of market goods consumed (X_{im}), leisure enjoyed (t_{il}), place characteristics (PC_{jm}), and harvest of subsistence resources, $S\left(t_{is}, X_{is}, PC_{js}\right)$ which is a function of

[9] This divergence has been a long-run pattern and real rates of unemployment are actually much higher in the small villages where many working age adults sit out of the labor force until they know jobs are available.
[10] The actual differences are even greater since these monetary measures do not take into account the high cost of living in the regions. Robinson and Fried (2005) estimated food costs relative to Anchorage to be 80% more in Nome and 150% more in Barrow.

time spent doing subsistence (t_{is}), market inputs to subsistence (X_{is}), and subsistence related place characteristics (PC_{js}),

$$U_{ij} = f\left(X_{im}, S\left(t_{is}, X_{is}, PC_{js}\right), t_{il}, PC_{jm}\right) \tag{1}$$

The household's budget's constraint reflects that expenditures equal income (there is no savings or debt),

$$P_m X_{im} + P_s X_{is} = w_m t_{im} \tag{2}$$

and time is fully allocated across working in the formal labor market for cash, harvesting subsistence resources, and enjoying leisure,

$$t_{im} + t_{is} + t_{il} = T \tag{3}$$

Maximizing utility subject to (2) and (3), households allocate labor across market activities, subsistence, and leisure such that marginal utilities are equal across the three activities. Simplifying related first order conditions, we see that utility is maximized when time is allocated in location j such that marginal utilities are equal across activities:

$$\frac{dU}{dX_{im}}\frac{w_m}{P_m} = \frac{dU}{dX_{is}}\frac{dS}{dX_{is}}\frac{w_m}{P_s} = \frac{dU}{dt_{is}}\frac{dS}{dt_{is}} = \frac{dU}{dt_{il}} .$$

In each location labor is allocated to maximize utility. Note that regional differences in place characteristics (PC_{js}, PC_{jm}) are important drivers of migration in the model. All else equal, in places with relatively good place characteristics (PC_{jm}) such as low crime rates, quality schools, or closed pipe water and sewer systems, labor will be allocated in the same way as in cities with different place characteristics but utility will be relatively higher.

This basic household production model suggests that, holding all else constant, increases in real wages (wages with respect to the price of market goods and the price of subsistence goods) increase the probability of migration to a region with higher real wages. Similarly, greater prospective utility in an alternative destination due to relatively better place characteristics (PC_{js} or PC_{jm}) suggests migration to that region as do reduced costs of migration (C_{ij}).

Relative values of PC_{js}, PC_{jm}, $\frac{w_m}{P_m}$, and $\frac{w_m}{P_s}$ may run in opposite directions. For instance, a migrant leaving a remote village for an urban area is leaving a place with relatively high subsistence place characteristics (PC_{js}) but with relatively low relative wages ($\frac{w_m}{P_m}$) and possibly low other place characteristics (PC_{jm}). Similarly, the model suggests that relative subsistence place characteristics (PC_{js}) is a key factor in a migrant's choice of returning to a rural village when leaving an urban area.

The empirical model outlined below focuses on prediction of destinations for the set of Arctic movers. In particular, we use a mixed multinomial choice model to test the extent to which relative expected earnings and subsistence productivity influence the probability of selecting a particular destination. The model accounts for place specific variables (e.g., predicted wages and subsistence place characteristics) and place invariant individual and household characteristics (e.g., age and household size) that are important components of the migration decision. Migration costs in the empirical model are reflected by the community spatial proximity embodied in the stepping stones model itself. The model is estimated on the set of Alaska Native movers from six different geographic regions. Figure 2 describes the stepping stones hierarchy used for modeling migration of Alaska Native people.

The Data

The 2000 US Decennial Survey of Population and Housing is the primary data source used in the empirical analysis. These microdata include long-form and short-form responses for the entire universe of US Census respondents,[12] and were accessed at a secure US Census Center for Economic Studies (CES) Research Data Center (RDC) at the University of California, Los Angeles.[14] Data used to estimate subsistence (Table 3.) is based on Alaska microdata from the Survey of Living Conditions in the Arctic (SLiCA).[16] SLiCA collected subsistence and other social indicator data from indigenous households living in the Arctic.

Migrants in our dataset were identified using long form responses to the place of residence question, the migrant category includes all respondents indicating a different community of residence in 2000 relative to 1995. Metadata used for analysis includes all Alaska Native respondents and household members currently living in Alaska and those living in another US state who reported living in Alaska five years previously.

While these data provide an excellent summary of migration, as with all survey data there are several sources of error. First, information is based on sample data. Census long-form questions on income, migration, education and other personal characteristics were administered to about 50% of rural Alaska households (more than double the average sample rate for the rest of the United States). The sample size for each region in the SLiCA survey was about 25%. Error is also

[12] The data reported in this paper were screened to ensure that no confidential information was inadvertently disclosed. Any opinions and conclusions expressed herein are those of the author(s) and do not necessarily represent the views of the U.S. Census Bureau.
[14] http://www.census.gov/ces/rdcresearch/index.html
[16] http://www.arcticlivingconditions.org/

introduced through imputations and substitutions for non-response. In some cases, surveys were not complete or information was inconsistent and the Census used substitutions or a hot-deck type imputation procedure to generate estimates for missing data. As will be discussed, imputed cases for certain variables (e.g., migration and income) were excluded in the regressions.

Earnings and Subsistence Predictions

The migration model accounts for predicted earnings and predicted subsistence. To predict earnings we use a two-step process. In the first step, the log of individual wages for Alaska Native respondents with positive earnings is regressed on a vector of individual characteristics,

$$\ln\left(w_{ij}\right) = \beta_0 + \beta_1 X_i^1 + u_i \tag{4}$$

for regions j = 1, … , 6 where X_i^1 is a vector of place invariant individual characteristics. Estimates are made for each region (j) and associated coefficients are used in the second step to predict earnings in each region for all Alaska Native respondents 16 years of age and older.[17]

Based on equation (4), we predict wages for individuals in each of six geographic regions (i.e., j = 1,…,6). The regional grouping designated "Arctic Villages" is made up of the 32 Arctic Villages and "Arctic Regional Centers" is made up of the three regional centers Barrow, Kotzebue and Nome. "Anchorage" is made up of the Anchorage Municipality and all places in the suburban Mat-Su Borough. "Other Rural Alaska" is made up of rural census districts besides places in the Arctic, and "other Urban" is made up of all other Alaska Census Areas which includes the state's larger communities. "Other State" includes respondents living in Arctic Alaska in 1995 but in another US State in 2000. We predict wages for all 6 regions for Alaska Native people 16 and older.

In the second step of the earnings predictions average hours worked per week is regressed on a vector of individual, household, and regional characteristics.[19] Predicted wages from the first step are included as a proxy for human capital. The equation to be estimated is,

$$h_{ij} = \beta_0 + \beta_1 X_i^2 + \beta_2 \hat{w}_{ij} + \beta_3 H_i + \beta_4 R_j + u_i \tag{5}$$

which was run separately for regional locations j = 1, … , 6. As above, X_i^2 is a vector of individual characteristics (different from X_i^1), H_i household characteristics, R_j regional characteristics, and $\hat{w}_{ij}$ is the individual predicted wage for region j. Regional characteristics are equal to the average of place characteristics in each region. Predicted earnings for each of the six regions are the product of the hours worked predictions from equation (5) and wage predictions from equation (4) for all Alaska Native adults 16 and older in the sample (i.e. $\hat{h}_{ij} \times \hat{w}_{ij}$ for j=1,…,6).

[17] Actual wages, w_{ij}, are derived by dividing total annual wage and salary earnings by average hours worked per year.
[19] Hours worked per week are censored at 0 and 60.

Individual subsistence harvest data used in our regressions is based on a prediction model described in Berman (2009). In his model, a Tobit specification is used to estimate household subsistence production based on individual, household, and subsistence related place characteristics,

$$s_{ij} = \beta_0 + \beta_1 X_i + \beta_2 H_i + \beta_3 PC_{js} + u_i \tag{6}$$

using SLiCA data. Our subsistence predictions are made using Berman's estimated coefficients on the corresponding variables available in the Census microdata.[21] SLiCA gathered individual and household information from one adult respondent in each housing unit, consequently we account for the fact that Berman's (2009) estimates are household predictions based on the characteristics of a randomly selected adult respondent.[22]

Migration predictions

To test for step-wise migration, we predict migration probabilities from region A to a set of alternative regions for movers using a mixed multinomial and conditional logit model (Cameron and Trivedi, 2005). This mixed model accounts for alternative specific characteristics (such as predicted earnings and subsistence) and individual fixed characteristics (such as age and gender).[23]

The mixed model we estimate is

$$y_{ij} = \beta_S S_{ij} + \beta_E E_{ij} + \alpha_j + \beta_{Aj} A_i + \beta_{Hj} H_i + \varepsilon_i \tag{7}$$

where S_{ij} denotes predicted subsistence harvest for individual i in destination j, E_{ij} predicted earnings, A_i is a vector of individual characteristics, and H_i is a vector of household characteristics. In this model we have a set of unordered alternatives (j), which are migration destinations (j = 1, …, 6), and individual i is choosing between the different destinations; if individual i chooses alternative j, $y_{ij} = 1$, otherwise $y_{ij} = 0$. As indicated, regressors that vary across alternatives include subsistence (S_{ij}) and earnings (E_{ij}), and as in the conditional logit model, respective regression

[21] Appendix 1 presents Berman's estimates used in our predictions. Individual characteristics in the model were gender, age, education, disability status, and ability to speak a Native language. Household characteristics included number of adult females, number of adult males, number of teens 16 and older, number of non-Natives in the household, an indicator if there are no men in the household (binary), number of children under 16, the number of children under 5, an indicator if it a household with a single female and children (binary). Regional variables included weighted regional employment in 2000, change in regional employment between 1995 and 2000, an indicator for the regional center (binary), an indicator if the community is coastal (binary), an indicator if the community is in proximity to caribou hunting (binary), and an indicator if the community is in proximity to salmon fishing (binary).

[22] In applying Berman's estimates to our data we randomly select an adult from each housing unit in the Census data and predict household level subsistence based on that adult's personal characteristics along with characteristics of others in the housing unit. The same household subsistence prediction is applied to everyone living in the housing unit.

[23] The mixed model used here combines alternative specific regressors from the conditional logit model with fixed characteristics of the multinomial logit model (Cameron and Trivedi, 2005). The multinomial model normally assigns regression coefficients across alternatives for place invariant independent variables (e.g., age and gender) and the conditional logit model assigns a single coefficient for place variant independent variables (e.g., subsistence and earnings). The mixed model used here differs from the random utility "mixed model" as described in McFadden and Train (2001).

coefficients don't vary across alternatives. Invariant alternatives include individual characteristics (A_i) and household characteristics (H_i), hence corresponding regression coefficients vary across alternatives as they do in the standard multinomial logit model with alternative invariant characteristics.

In the mixed model, individual i's probability of moving to destination j can be written as,

$$p_{ij} = Pr\left[y_i = j\right] = \frac{\exp\left(\beta_S S_{ij} + \beta_E E_{ij} + \alpha_j + \beta_{Aj} A_i + \beta_{Hj} H_i\right)}{\sum_{k=1}^{5} \exp\left(\beta_S S_{ik} + \beta_E E_{ik} + \alpha_k + \beta_{Ak} A_i + \beta_{Hk} H_i\right)} \text{ , j = 1, 2, …, 5} \quad (8)$$

where subscripts j or k denote alternative destinations. As indicated in (8), this probability equation simply combines components of the conditional and multinomial logit models.

Our analysis is only on respondents who move during the five year period since our focus is on identifying patterns and determinants of migration. Given our modeling approach, by focusing only on movers, we avoid combining alternatives that may not be independent. In multinomial models the odds ratio of any two alternatives are assumed to be independent of other alternatives (i.e., the independence of irrelevant alternatives). As such, if place A is preferred to place B this relation should hold irrespective of the alternatives added to the model. Independence of irrelevant alternatives also implies that the odds ratio between destination A and destination B is constant regardless of the addition of destination C. Constant relative odds may make sense between different migration destinations but it seems problematic when a stay option is added as an alternative. In Arctic regions upwards of 50% of the population choose to "stay" (Howe, 2009). It seems more appropriate to either model the stay and move decisions in nested logit framework or just to focus the multinomial choice model on movers. In the current paper we choose the latter approach, hence we exclude "stayers" from our analysis.

Results

Labor market equations

Estimates from the hourly wage regressions in equation (1) are presented in Table 4 of the appendix. Across all six regions, personal characteristic are generally significant in the wage regressions. Wage rates increase with age but at a diminishing rate. In every region females earn significantly less than men, the difference is about 10% in Arctic Villages, 17% in Regional Centers, and 30% in Anchorage. Across all regions increased education is associated with higher wages, Alaska Natives with a BA degree make about 60% more in Arctic Regional Centers and 34% more in Arctic Villages compared to people with less than a high school degree.

Hours worked regressions based on equation (5) are presented in Table 5 of the appendix. Predicted hours worked was estimated for all Alaska Native respondents 16 years and older irrespective of current labor force participation. As expected, predicted wages are a robust indicator of hours worked – an increase in wages of $1/hr increases hours worked by about 95 hours per year in Arctic Villages and Regional Centers. Being female has a mixed effect on hours worked across locations, increasing hours worked in Arctic Villages and Regional Centers while decreasing hours worked in other locations.[24]

Household characteristics also have mixed effects on hours worked. Individuals from large households (n>5) (bighh) are predicted to work fewer hours than smaller households in most regions. Households made up of a single mother with children (mom_un6) work significantly more hours in Arctic Regional Centers than individuals from other households types but fewer hours in urban regions.[25]

Place characteristics in Table 5 include change in employment (empchange_region), weighted total employment (wemp00_region), and dummy variables for coastal places and places where caribou and salmon are harvested. The coastal, caribou, and salmon variables control in part for the different subsistence characteristics of villages in our study region.[26] When significant, the effect of coastal, caribou, and salmon on hours worked in the formal labor market is generally negative, since time allocated to subsistence trades off with time allocated to formal market activities. The exception is living in an Arctic Village where caribou can be harvested. In Arctic Villages, "caribou" has the effect of increasing predicted hours worked possibly reflecting Northwest Arctic Villages that are in proximity to the Red Dog mine (with greater employment opportunities) where the income effect on subsistence hunting outweighs the substitution effect.

Hierarchical migration

Predicted hours worked and wages are multiplied to generate predicted earnings for Alaska Natives 16 and older. Predicted subsistence and earnings are then used in estimating equation (7), the multinomial mixed model. The mixed model was run with place variant characteristics (predicted earnings and predicted subsistence) and place invariant dummy variables (female, youth, elder, solo household, large household, and married couple household); odd ratios are shown in Table 6 of the appendix.[27] Coefficients of place invariant variables are

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[24] This is consistent with the fact that female labor force participation rates are relatively greater in many Arctic Villages compared to other Alaska locations.

[25] This may be due in part to a larger social network in Arctic places which would reduce the opportunity costs of outside employment for single parents.

[26] For instance, all North Slope villages participate in whaling but there is no whaling in the Nome Census Area. Similarly, subsistence salmon harvests are important for all villages in the Nome Census Area but salmon do not spawn near any North Slope Borough villages.

[27] The odds ratio (or relative-risk ratio) provides information on the probability of choosing destination j relative to some other alternative (k in this example) when x_i changes by one unit, $\frac{P(y_i=j)}{P(y_i=k)} = e^{x_i\beta_j}$

relative to the base category, migration to another US state. We also ran the multinomial model with different place invariant characteristics (female and Iñupiat) but the same place variant characteristics. Results of these regressions are presented in Table 7 of the appendix.[28]

To explore specific hypotheses related to hierarchal migration we calculate probabilities as indicated in equation (8). Probabilities associated with moving out from an Arctic Village, an Arctic Regional Center, Anchorage, or another Rural Alaska area, are provided in Tables 1 and 2. Table 1 presents probabilities associated with the full set of characteristics and Table 2 presents probabilities from the limited set of place invariant characteristics, female and Iñupiat.

Result #1: Stepwise migration is consistent with Arctic migration patterns.

Stepwise migration predicts that people move up through the hierarchy one step at a time. Migration consistent with a stepping stones hypothesis implies three distinct characteristics: (1) a hierarchy with three or more levels of community size or relative urbanization; (2) a dominant pattern of movement "up" the hierarchy, one step at a time, toward more urban or larger places; and (3) a dominant pattern of movement at each hierarchical step to the nearest community of that size (Figure 1). For Alaska, this pattern is represented in Figure 2. For movement down the hierarchy, step-wise consistent migration includes a propensity to move one-step at a time toward less urban places.

Here we observe a dominant pattern of migration up the hierarchy consistent with the stepping stones hypothesis. Controlling for expected earnings and subsistence production as well as individual characteristics, we find that Alaska Native movers from the Arctic are most likely to move one step up the hierarchy independent of their place of origin. In most cases, half or more of the movers from each destination follow this path. As indicated in Table 1., probability of moving to a Regional Center from an Arctic Village is 49% while the probability of moving from a Regional Center to Anchorage is 59%. For Iñupiat migrants leaving Anchorage (Table 2.) the probability of moving out of State is 23%, greater than for any other origin.

As indicated in Table 2., migration patterns for Iñupiat people are also consistent with the stepping stones hypothesis; they are more likely to move up the hierarchy in small steps from Arctic Villages to Regional Centers to larger Urban areas. Notably, as with other Alaska Natives, Iñupiat people leaving Anchorage are more likely to choose an out of State destination (0.225) compared to any other destination. At the same time, however, there are different patterns for Iñupiat people leaving Anchorage. Marginal effects indicate that Iñupiat people leaving

[28] Including "Iñupiat" allows us to predict Iñupiat migration for Alaska Natives leaving the Anchorage region as well as other Rural and Urban areas. Respondents who selected Alaska Native or American Indian on the 2000 Census were asked to provide a tribal designation. Restricting analysis to entirely to Iñupiat movers wasn't possible due to high non-response to this question particularly in urban areas.

Anchorage are significantly more likely to move to an Arctic Village (marginal difference 0.283 (p=0.000)) or to an Arctic Regional Center (marginal difference 0.237 (p=0.000)) relative to other Alaska Native people. They are also less likely to move out of State (marginal difference -0.390 (p=0.000)) or to a village in another rural area (marginal difference -0.099 (p=0.000)) compared to other Alaska Native people; indeed across all origins Iñupiat people are less likely to move to an out of state location relative to other Alaska Native people.

Result #2: Expected earnings are an important determinant of migration from Arctic Villages.

For migrants leaving Arctic Villages, the effect of relative earnings on migration is consistent with the stepping stones hypothesis. An earnings premium has the strongest effect on migration decisions up the hierarchy from an Arctic Village to a Regional Center or to Anchorage. Marginal effects (Table 8.) indicate that a relative increase of $1000 in predicted earnings at the destination increases the probability of moving from an Arctic Village to a Regional Center by 6.3%, to Anchorage by about 6.2%, to another rural location by about 0.044%, and from an Arctic Village another US place outside of Alaska by 1.2%.

Probably more importantly, for migrants leaving Arctic Regional Centers or Anchorage, a relative increase in earnings doesn't significantly influence the probability of migration to a particular location. In contrast to model predictions, relative earnings don't appear to dominate Arctic migration decisions after controlling for other factors. As discussed below, household and individual characteristics are important suggesting other factors, such as educational opportunities for children, are important determinants of the destination selected.

Result #3: In moving down the hierarchy, subsistence is a key migration determinant

Note that migration down the hierarchy, while not accounted for by Ravenstein's early models, is an important feature of Arctic migration patterns (Howe, 2009). In leaving locations with high subsistence potential (i.e. Arctic Villages and Regional Centers), relative subsistence opportunities in other locations don't appear to be important. However, when leaving places with relatively poor subsistence potential, Anchorage or Other Rural locations, relative subsistence is an important determinant of the destination selected (Table 6). Marginal fixed effects indicate that a 10% relative increase in subsistence opportunities increases the probability of choosing an Arctic Village when leaving Anchorage by around 4.4% (p=0.000) and an Arctic Regional Centers by about 3.5% (p=0.000) (Table 8.).

In general, better subsistence opportunities appear to increase the probability of migration to a place down the hierarchy. As result #2 indicated, in moving up the hierarchy relative earnings is an important determinant of place when leaving Arctic Villages. Migrants leaving Arctic Regional Centers appear to choose destinations based on criteria other than relative wages or subsistence place amenities.

Result #4: Age and family characteristics influence hierarchical migration

There are, however, several place invariant personal characteristics important for migrants leaving Arctic Regional Centers. As indicated by marginal effects in Table 8., married couples are less likely to leave Arctic Regional Centers for Anchorage compared to other family types (-0.22) while single person households are more likely to leave Regional Centers for Anchorage compared to larger households (0.28). Married couple households are also less likely to move directly from an Arctic Village to Anchorage (-0.31); compared to solo households, married couple households possibly have relatively deeper social networks in the Arctic making migration out of the Arctic more costly. However, when Alaska Natives are already living in a destination outside of the Arctic, married couple households are more likely to leave Anchorage for an out of State destination relative to other household types (0.24). In contrast, large households with six or more people are less likely to move to an out of State location from Anchorage (-0.20) or from Arctic Regional Centers (-0.15) compared to smaller households.

In terms of age, migrant elders 65 and older are significantly less likely than others to choose an out of state location from Arctic Villages (-0.06) or an Arctic Regional Center (-0.11). Similarly, they are less likely to leave Anchorage, Alaska's medical service hub, for an Arctic Regional Center compared to other age groups (-0.04). Young people, ages 16-19 are more likely to move to an out of state location from Regional Centers (0.24) and Anchorage (0.12) compared to other age groups; likely to attend college or search for employment abroad.

In moving down the hierarchy, female and Iñupiat are the only positive and significant personal characteristics indicating a greater likelihood of selecting a location down the hierarchy. Females are more likely to move from Anchorage to Regional Centers, as discussed below, also, it's not surprising that Alaska Natives with Iñupiat ancestry are more likely than other Alaska Natives to move from Anchorage to an Arctic Village (0.28), to an Arctic Regional Center (0.24), or to move from a Regional Center down to an Arctic Village (0.13). In contrast, married couple households are less likely to move from Anchorage to Arctic Villages (-0.04) or to Arctic Regional Centers (-0.03) relative to other household types. Single person households are less likely to move from an Arctic Regional Center to an Arctic Village (-0.14) as are young people (-0.11).

Result #5: Stepping stone migration differs between men and women.

Finally, in terms of gender differences, for men the stepping stones hypothesis seems robust. From the three main origins (Arctic Villages, Regional Centers, and Anchorage), for men, the probability of moving one step up the hierarchy is greater than all other alternatives combined. From villages to Regional Centers, marginal differences between women and men are -0.252 (p=0.027) indicating men are more likely to move from villages directly to Regional Centers compared to women (Table 8.). In contrast, marginal differences indicate women are significantly more likely to bypass the Regional Center and move directly from an Arctic Village to Anchorage (0.249; p=0.025) compared to men. In terms of migration down the hierarchy, women are slightly more likely than men to move from Anchorage back to an Arctic Regional center (0.023; p=.021).[29]

In moving down the hierarchy, if a stepping stone pattern of migration were representative, we should observe a relatively greater probability of migration from Anchorage to Regional Centers than Anchorage to Arctic Villages. In general the evidence seems mixed. Iñupiat migrants who leave Anchorage for an Arctic location are about equally likely to go to Arctic Villages or to Regional Centers over other destinations (Table 2). Iñupiat women leaving Anchorage, however, are most likely to choose an Arctic Regional Center (33%) while Iñupiat men are more likely to choose an Arctic Village (37%) over other destinations. Marginal fixed effects are consistent with this difference. Women are more likely than men to move from Anchorage back to the Regional Center (0.02; p=0.021) while men may be more likely to move from Anchorage to a village (-0.01; p=0.225).

Conclusion

While not universal across all destinations, we find evidence generally consistent with a stepping stones hypothesis of migration. Controlling for predicted income and subsistence across places and individual characteristics we find that Alaska Native people moving in the Arctic are more likely to move up one level in a step-wise hierarchical fashion – from an Arctic Village to an Arctic Regional Center and from an Arctic Regional Center to Anchorage. Also, Iñupiat migrants living in Anchorage are more likely to move to another State compared to migrants leaving Arctic Villages, Arctic Regional Centers, or other rural parts of Alaska.

These findings are broadly consistent with Ravenstein's (1885) early hypothesis of step-wise migration: that migration tends to flow from small to larger adjacent communities as migrants fill in gaps left by those moving up the hierarchy. Ravenstein provided two explanations for the stepping stone pattern of migration up the hierarchy, opportunities and distance. Increased opportunities for education and earnings can account for step-wise migration patterns and

[29] Marginal differences between men and women moving from regional centers to other destinations are not significant.

pursuing these opportunities attracts both those seeking education and those with education (Zhang, 2002).[30] Our findings for migrants leaving Arctic Villages are consistent with this explanation, however, we find education and earnings to be a less important predictor of destinations for migrants leaving Regional Centers and more Urban areas. Relative earnings doesn't dominant migration decisions as predicted by earlier models (e.g. Harris and Todaro, 1970).

The importance of distance is also highlighted by our findings. As noted by Lucas (2001) and Greenwood (1997), distance affects monetary, social, and psychic costs of moving making shorter moves more attractive.[31] This seems particular true in the Arctic where there are strong social networks important in securing food and protecting against risk (Magdanz et. al., 2002). In our setting, close moves also reduce the costs of acquiring information about employment as well as knowledge of the environment, essential to engaging in subsistence harvests. Language and culture is also more similar closer to the origin and return migration, in the event of an unexpected shock, is less costly in a destination closer to the starting point.

Our results also highlight the importance of age, gender, and position in the life cycle. Consistent with findings of Plane et. al. (2005) we find important differences across age, household type, and household size. As in their study, young people and solo households move up the hierarchy at greater rates compared to other age groups or household types. We also observed gender differences as Iñupiat women who leave Arctic Villages are more likely than men to move directly to Anchorage, bypassing the Regional Center. This result is consistent with findings of a gender imbalance in the young working age population; young Alaska Native women in Arctic places have moved out of villages at greater rates than young men and they hold a disproportionate share of skilled labor market positions (Kleinfeld et. al., 1983; Hamilton and Seyfrit, 1994; Hamilton et. al., 1997). Where migrants choose to live is a function of place, personal, and household characteristics.

Finally, we don't observe trends leading to a dramatic shift in population from rural to urban areas. As with Plane et. al. (2005) we observe a large degree of return migration, and for some regions, evidence of step-wise migration down the hierarchy. We find that subsistence place amenities don't appear to play an important role in migration up the hierarchy but subsistence appears to be an important determinant when migrating down the hierarchy from large urban areas. The role of subsistence may also be related to the observed gender differences; on average Iñupiat women are more likely to go from Anchorage to an Arctic Regional Center while Iñupiat

[30] For Finland, Ritsila and Ovaskainen (2001) show that migration up the hierarchy has resulted in the centralization of human capital.

[31] Also, gravity models of migration predict that place to place migration declines with distance as rural residents work their way ever closer to bigger urban centers (Greenwood, 1997).

men, who may place a higher premium on subsistence possibilities, appear more likely to bypass the Regional Center and move directly to an Arctic Village.

Our findings support a stepping stones or hierarchal migration pattern for the Arctic. There are differences in these general patterns, however, in migration up the hierarchy and migration down the hierarchy and between men and women. In moving from Arctic Villages to Regional Centers relative earnings is a key factor in the migration decision while things other than income are more important in migration patterns from Arctic Regional Centers to Anchorage (undoubtedly healthcare, schools, and other place amenities in Anchorage weigh heavily in this decision). In selecting a community down the hierarchy, subsistence opportunities and station in life (e.g., elders and married couple families) appear to be more important predictors than relative earnings.

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Appendix 1.

Table 1. Choice of migration destinations: predicted migration probabilities (based on coefficients in Table 6.)*

		Origin			
		Villages	Regional Centers	Anchorage	Other Rural
	Males and Females				
Destination	Rural	0.0017	0.0407	0.1578	
	Villages		0.1794	0.0387	0.0092
	Regional Centers	0.4901		0.0309	0.0055
	ANC	0.4590	0.5946		0.5683
	Fair / other urban	0.0005	0.0845	0.1872	0.2994
	Other US	0.0487	0.1007	0.5855	0.1175
	Females				
Destination	Rural	0.0010	0.0470	0.1876	
	Villages		0.2008	0.0325	0.0072
	Regional Centers	0.3719		0.0437	0.0051
	ANC	0.5772	0.6006		0.5719
	Fair / other urban	0.0006	0.0840	0.1835	0.2789
	Other US	0.0494	0.0676	0.5526	0.1368
	Males				
Destination	Rural	0.0031	0.0340	0.1279	
	Villages		0.1549	0.0464	0.0128
	Regional Centers	0.6243		0.0206	0.0059
	ANC	0.3278	0.5749		0.5590
	Fair / other urban	0.0003	0.0830	0.1888	0.3277
	Other US	0.0445	0.1530	0.6163	0.0945

Table 2. Choice of Iñupiat migration destinations: predicted migration probabilities (based on coefficients in Table 7.)*

		Origin			
		Villages	Regional Centers	Anchorage	Other Rural
	Males and Females				
Destination	Rural	0.0084	0.0281	0.0733	
	Villages		0.2169	0.2941	0.1277
	Regional Centers	0.5258		0.2514	0.0330
	ANC	0.3419	0.6205		0.4645
	Fair / other urban	0.0981	0.0827	0.1557	0.3748
	Other US	0.0259	0.0518	0.2255	0.0000
	Females				
Destination	Rural	0.0046	0.0298	0.0847	
	Villages		0.2068	0.2288	0.1092
	Regional Centers	0.4093		0.3264	0.0330
	ANC	0.4338	0.6370		0.4924
	Fair / other urban	0.1226	0.0837	0.1491	0.3655
	Other US	0.0297	0.0426	0.2110	0.0000
	Males				
Destination	Rural	0.0153	0.0263	0.0594	
	Villages		0.2277	0.3730	0.1572
	Regional Centers	0.6514		0.1790	0.0329
	ANC	0.2420	0.6007		0.4251
	Fair / other urban	0.0707	0.0813	0.1563	0.3849
	Other US	0.0206	0.0640	0.2322	0.0000

*Probabilities are for the set of Iñupiat migrants.

Table 3. Reduced-form censored regression equations for household harvests (Berman, 2009)*

Personal Characteristics	
Female	0.0315 (0.79)
Age	0.01082 (1.81)
Age squared	-0.0002 -(2.41)
Education level	0.0319 (1.54)
Subsistence Skills	0.0135 (3.24)
disability status	-0.081 -(1.58)
Family ties index	0.025 (3.09)
HH Characteristics	
Native lang at home	0.0644 (3.83)
N females aged 18+ in HH	0.068 (2.51)
N males aged 18+ in HH	0.042 (1.50)
N teens aged 16-17 in HH	0.017 (0.46)
N elders aged 65+ in HH	0.0752 (1.72)
Non-native HH member	0.006 (0.15)
No men in HH	-0.141 -(1.95)
N kids under 16 in HH	0.023 (1.82)
N kids under five in HH	-0.0757 -(2.81)
No men times kids < 5	0.097 -(1.60)
Place Characteristics	
Total Employment (1000's), 2000	-0.206 -(2.04)
Emp. Change, 1990-2000	-0.04128 -(0.52)
Regional Center	0.136 (0.84)
Coastal Community	0.0972 (2.05)
Caribou using community	0.142 (3.15)
Salmon Using community	0.109 (2.28)
Intercept	-0.561 -(3.46)
* Y=Total household subsistence harvests t statistics in parentheses	

Table 4. Ordinary least squares hourly wage regressions (lnhrwage)*

	(Regression 1) Out-Migration From: Other Rural	(Regression 2) Out-Migration From: Villages	(Regression 3) Out-Migration From: Regional Centers	(Regression 4) Out-Migration From: Anchorage	(Regression 5) Out-Migration From: Other Urban	(Regression 6) Out-Migration From: Other US
age	0.03572 (5.60)	0.05620 (6.00)	0.05402 (3.99)	0.05986 (6.12)	0.03742 (3.05)	0.03857 (2.17)b
agesq	-0.00032 -(3.99)	-0.00058 -(4.94)	-0.00054 -(3.15)	-0.00057 -(4.53)	-0.00028 -(1.71)c	-0.00032 -(1.44)
female	-0.17317 -(6.50)	-0.10276 -(2.49)	-0.16937 -(2.75)	-0.30517 -(7.28)	-0.24094 -(6.52)	-0.08739 -(1.12)
hsgrad	0.10558 (2.75)	0.05411 (0.98)	0.30801 (3.90)	0.17749 (2.52)	0.15364 (2.57)	0.13641 (1.03)
somecoll	0.34004 (8.09)	0.15672 (2.55)	0.37924 (4.90)	0.30525 (4.66)	0.30842 (4.92)	0.23468 (1.85)c
badegree	0.70964 (10.10)	0.33768 (2.85)	0.60178 (6.21)	0.48088 (5.95)	0.38780 (4.04)	0.41493 (2.73)
postba	0.77575 (6.94)	0.74159 (1.71)c	0.62565 (3.22)	0.65908 (4.87)	0.77142 (6.87)	0.69623 (3.54)
veteran	0.04270 (0.94)	-0.02715 -(0.42)	0.00729 (0.08)	-0.07163 -(1.24)	0.00399 (0.06)	0.21611 (1.77)c
schlnow	-0.03340 -(0.75)	-0.28829 -(3.42)	0.10440 (1.20)	-0.03931 -(0.74)	0.01736 (0.28)	-0.10094 -(0.91)
_cons	1.57156 (14.01)	1.43620 (8.24)	1.48112 (6.07)	1.15035 (7.01)	1.47411 (7.31)	1.30730 (3.89)
Observations	4528	1487	767	1331	2360	493
F statistic	49.88	15.52	16.8	40.94	34.17	9.3
R-squared	0.0927	0.1023	0.1523	0.2318	0.1397	0.1711
Root MSE	0.81518	0.71757	0.68635	0.62474	0.7293	0.71118
*t-statistics in parenthesis						

Table 5. Censored Tobit "hours worked" equations*

	(Regression 1) Out-Migration From: Other Rural	(Regression 2) Out-Migration From: Villages	(Regression 3) Out-Migration From: Regional Centers	(Regression 4) Out-Migration From: Anchorage	(Regression 5) Out-Migration From: Other Urban	(Regression 6) Out-Migration From: Other US
pwage_region	74.66 (14.52)	95.91 (8.01)	95.38 (9.31)	62.25 (6.30)	44.64 (5.43)	26.33 (1.45)
youth	-514.23 -(11.04)	-617.64 -(5.86)	-376.48 -(2.74)	-673.46 -(6.28)	-743.22 -(9.00)	-620.16 -(3.97)
elder	-1609.69 -(23.65)	-1804.43 -(12.59)	-1693.30 -(7.78)	-2370.0 -(11.4)	-2106.28 -(18.80)	-1636.33 -(3.37)
female	-60.08 -(2.09)	87.51 (1.62)	139.06 (1.66)	-178.45 -(2.48)	-214.74 -(4.20)	-433.16 -(4.30)
married	277.96 (9.02)	302.67 (5.32)	145.09 (1.64)	50.40 (0.71)	185.23 (3.39)	74.60 (0.65)
disabwk	-111.36 -(3.03)	232.13 (3.29)	-554.92 -(4.24)	-897.36 -(9.46)	-813.02 -(9.62)	-440.19 -(3.07)
native_lang	-315.08 -(10.53)	-263.66 -(4.90)	-220.30 -(2.60)	-423.24 -(3.54)	-427.52 -(4.84)	-152.27 -(0.47)
solohh	-5.09 -(0.10)	73.84 (0.70)	131.94 (0.88)	-110.43 -(0.98)	-16.51 -(0.20)	216.20 (1.25)
bighh	-159.93 -(5.22)	-87.00 -(1.63)	-176.87 -(2.01)	-88.30 -(1.05)	-258.92 -(3.29)	-302.04 -(1.65)
mom_un6	-8.19 -(0.14)	158.64 (1.51)	320.31 (2.23)	-25.26 -(0.23)	-226.72 -(2.23)	-412.87 -(2.06)
empchange_region	69.52 (2.86)	-158.01 -(1.92)	--	212.09 (1.64)	-4.63 -(0.48)	--
wemp00_region	0.25 (10.62)	0.63 (1.58)	-0.14 -(1.24)	0.00 (2.14)	0.01 (2.53)	--
coastal_region	-1.44 -(0.05)	0.99 (0.01)	91.77 (0.90)	--	-296.51 -(5.30)	--
caribou_region	-78.34 -(2.71)	318.58 (5.98)	--	122.21 (0.6)	-59.14 -(1.19)	--
salmon_region	-176.08 -(1.76)	-78.54 -(1.50)	--	--	108.71 (1.09)	--
_cons	344.02 (2.70)	-628.08 -(2.93)	-317.08 -(1.13)	564.11 (1.88)	978.10 (5.21)	1341.10 (3.23)
/sigma	1015.31	1090.92	1177.45		1171.96	1153.71
Observations	8209	2852	1337		4554	856
F statistic	158.63	56.79	40.18		69.2	10.5
Pseudo R2	0.0289	0.0333	0.0302		0.0262	0.0147
Ll	5135.42	320.091	180.82		4108.79	777.534

*t-statistics in parenthesis

Table 6. Choice of migration destinations: mixed multinomial logit (odds ratios presented as coefficients) *

		(Regression 1) Out-Migration From: Other Rural		(Regression 2) Out-Migration From: Villages		(Regression 3) Out-Migration From: Regional Centers		(Regression 4) Out-Migration From: Anchorage	
		coef	t-stat	coef	t-stat	coef	t-stat	coef	t-stat
predicted earnings		1.00	(0.10)	1.00	(4.13)	1.00	-(1.49)	1.00	-(0.37)
predicted subsistence		268.50	(4.66)	0.004	-(1.09)	23.46	(1.19)	137209.50	(9.06)
female	other rural			0.29	-(0.87)	3.13	(1.42)	1.64	(2.30)
	villages	0.39	-(1.55)			2.94	(1.62)	0.78	-(0.77)
	regional centers	0.60	-(0.64)	0.54	-(0.73)			2.37	(2.34)
	anchorage	0.71	-(0.74)	1.59	(0.56)	2.37	(1.28)		
	other urban	0.59	-(1.11)	1.64	(0.46)	2.29	(1.11)	1.08	(0.28)
youth	other rural			3.54	(0.68)	0.06	-(2.18)	0.61	-(1.47)
	villages	2.69	(1.31)			0.11	-(2.82)	0.44	-(1.62)
	regional centers	2.06	(0.72)	7.23	(1.46)			0.74	-(0.62)
	anchorage	0.45	-(1.37)	6.06	(1.34)	0.17	-(2.32)		
	other urban	0.68	-(0.64)	0.00005	-(7.42)	0.39	-(0.93)	0.57	-(1.32)
elder	other rural			0.31	-(0.76)	0.04	-(3.34)	0.64	-(0.68)
	villages	0.0003	-(6.90)			6847.85	(8.42)	1.14	(0.13)
	regional centers	0.0005	-(6.45)	12345.54	(8.72)			0.0003	-(17.64)
	anchorage	1.65	(0.43)	6012.22	(6.77)	3889.82	(5.62)		
	other urban	2.89	(0.80)	0.02	-(3.20)	0.02	-(4.22)	1.21	(0.25)
solohh	other rural			0.0002	-(5.77)	1.25	(0.14)	0.92	-(0.27)
	villages	0.0005	-(7.07)			0.23	-(0.97)	1.03	(0.07)
	regional centers	0.0008	-(6.39)	0.95	-(0.04)			0.64	-(0.70)
	anchorage	2.41	(0.79)	1.24	(0.17)	1.55	(0.38)		
	other urban	2.12	(0.66)	3.78	(0.92)	0.00	-(10.03)	1.06	(0.11)
bighh	other rural			0.00002	-(6.00)	6.03	(1.67)	1.52	(1.21)
	villages	3.07	(1.69)			19.38	(3.35)	2.92	(2.33)
	regional centers	0.76	-(0.28)	0.83	-(0.13)			1.38	(0.65)
	anchorage	1.21	(0.33)	0.17	-(1.07)	13.67	(2.84)		
	other urban	1.21	(0.32)	0.00003	-(5.74)	10.31	(2.23)	2.89	(2.00)
married	other rural			5.66	(0.84)	0.62	-(0.54)	0.27	-(5.28)
	villages	1.37	(0.47)			0.31	-(1.64)	0.25	-(3.70)
	regional centers	2.62	(1.16)	3.29	(0.80)			0.30	-(3.21)
	anchorage	0.50	-(1.43)	0.76	-(0.17)	0.23	-(1.99)		
	other urban	0.66	-(0.81)	0.00003	-(6.25)	0.94	-(0.07)	0.53	-(2.00)
Wald chi2		981.35		2665.92		1033.35		1113.33	
Log pseudolikelihood		-1851.6354		-565.89526		-1007.1393		-3263.7721	0.53
# of observations (# of cases)		1585 (317)		765 (153)		860 (172)		3800 (760)	

*t-statistics in parenthesis. Other US State is used as the base category.

Table 7. Choice of migration destinations: mixed multinomial logit (odds ratios presented as coefficients) *

		(Regression 1) Out-Migration From: Other Rural	(Regression 2) Out-Migration From: Villages	(Regression 3) Out-Migration From: Regional Centers	(Regression 4) Out-Migration From: Anchorage
predicted earnings		1.00 (0.19)	1.00 (4.23)	1.00 -(0.86)	1.00 -(1.69)
predicted subsistence		272.32 (4.72)	0.01 -(0.92)	10.49 (0.81)	75933.27 (8.83)
female	Anchorage	0.65 -(0.94)	1.24 (0.22)	1.59 (0.69)	--
	Other urban	0.53 -(1.32)	1.20 (0.15)	1.54 (0.57)	1.05 (0.17)
	Regional Centers	0.56 -(0.69)	0.43 -(0.84)	--	2.01 (1.57)
	Other Rural	--	0.21 -(1.15)	1.70 (0.72)	1.57 (2.18)
	Villages	0.39 -(1.52)	--	1.36 (0.48)	0.68 -(0.90)
Iñupiat	Anchorage	8170.21 (11.05)	2.97 (1.11)	9.69 (3.57)	--
	Other urban	12763.90 (12.51)	3.22 (0.97)	1.52 (0.56)	2.29 (1.51)
	Regional Centers	24981.51 (8.67)	11.41 (2.58)	--	46.91 (7.30)
	Other Rural	--	0.84 -(0.12)	1.86 (0.83)	1.16 (0.30)
	Villages	56073.05 (17.15)	--	12.25 (4.00)	69.47 (8.19)
Wald chi2		632.97	44.80	35.67	231.96
Log pseudolikelihood		-1883.77	-649.84	-1006.58	-3055.01
# of observations (# of cases)		1585 (317)	765 (153)	860 (172)	3800 (760)

*t-statistics in parenthesis. Other US State is used as the base category.

Table 8. Select marginal effects of regression coefficients

		wages*	subsistence*	female*	youth*	elder*	solohh*	bighh*	married*	Iñupiat**	female**
Migration UP the Hierarchy	Arctic Village to Regional Center	6.30E-05	-1.4130	-0.2524	0.0743	0.2016	-0.0580	0.2980	0.3363	0.3233	-0.2305
		(4.14)	-(1.09)	-(2.21)	(0.55)	(0.63)	-(0.28)	(1.85)	(3.22)	(3.90)	(-2.19)
	Arctic Village to Anchorage	6.20E-05	-1.4050	0.2494	-0.0134	-0.1417	0.0663	-0.3334	-0.3089	-0.1645	0.1915
		(3.99)	-(1.10)	(2.24)	-(0.10)	-(0.44)	(0.32)	-(2.23)	-(2.93)	(-1.45)	(1.80)
	Arctic Village to Other US	1.20E-05	--	0.0048	-0.0563	-0.0572	-0.0035	0.0432	-0.0236	-0.0878	0.0115
		(2.63)		(0.14)	-(1.74)	-(2.01)	-(0.07)	(0.44)	-(0.50)	(-1.36)	(0.29)
	Arctic Regional Center to Anchorage	-1.80E-05	0.7610	0.0257	-0.1506	0.0729	0.2833	0.0860	-0.2178	0.3049	0.0415
		-(1.49)	(1.20)	(0.24)	-(1.16)	(0.25)	(2.29)	(0.82)	-(2.02)	(3.33)	(0.37)
	Arctic Regional Center to Other US	-6.70E-06	--	-0.0855	0.2412	-0.1067	-0.0012	-0.1517	0.1207	-0.2035	-0.0423
		-(1.33)		-(1.48)	(1.84)	-(3.49)	-(0.01)	-(3.33)	(1.58)	(-2.77)	(-0.74)
	Anchorage to Other US	-1.40E-06	--	-0.0636	0.1236	0.0315	0.0079	-0.1983	0.2345	-0.3901	-0.0553
		-(0.37)		-(1.31)	(1.88)	(0.21)	(0.10)	-(2.10)	(4.63)	(-5.18)	(-1.13)
Migration DOWN the Hierarchy	Anchorage to Arctic Villages	-2.10E-07	0.4400	-0.0139	-0.0194	0.0077	0.0018	0.0343	-0.0355	0.2826	-0.0088
		-(0.36)	(5.32)	-(1.21)	-(1.66)	(0.19)	(0.10)	(1.37)	-(3.14)	(5.60)	(-1.20)
	Anchorage to Regional Center	-1.70E-07	0.3540	0.0231	-0.0033	-0.0392	-0.0113	-0.0022	-0.0234	0.2368	0.0129
		-(0.37)	(4.95)	(2.31)	-(0.26)	-(5.93)	-(0.84)	-(0.18)	-(2.42)	(5.36)	(1.52)
	Arctic Regional Center to Arctic Village	-1.10E-05	0.4650	0.0459	-0.1058	0.1712	-0.1393	0.0985	-0.0213	0.1297	-0.0129
		-(1.48)	(1.17)	(0.69)	-(2.07)	(0.60)	-(2.58)	(1.31)	-(0.36)	(2.88)	(-0.22)

* Based on regression results in Table 6. (full set of personal characteristics)
** Based on regression results in Table 8 (limited set of personal characteristics)
z-statistics in parentheses

Figure 1. Hypothetical Stepping Stones Model of Hierarchical Internal Migration.

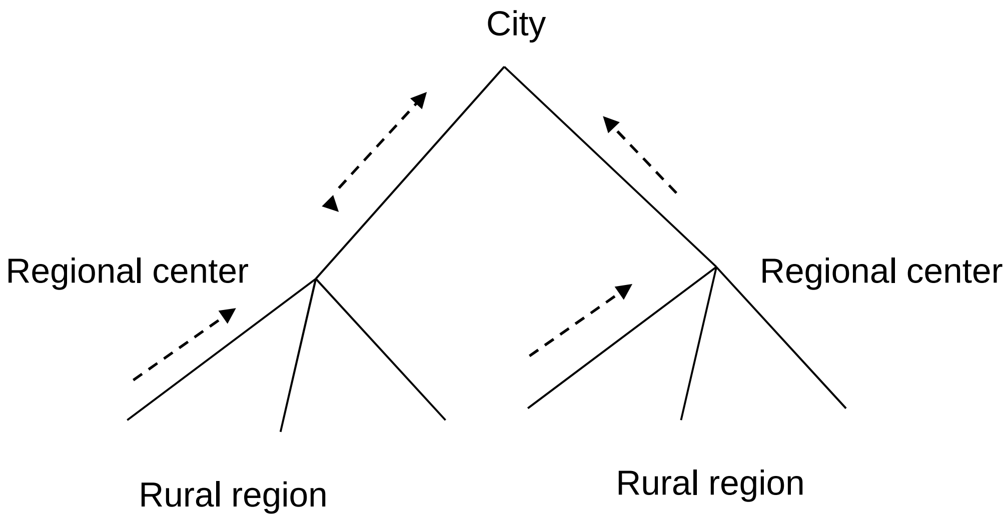

Figure 2. Hierarchical Migration Model for Iñupiat in Arctic Alaska