An empirical test of the restrictions in a net migration equation

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An empirical test of the restrictions in a net migration equation

Perrigo, Thomas A., M.A.
University of Nevada, Las Vegas, 1994
AN EMPIRICAL TEST OF THE RESTRICTIONS IN A NET MIGRATION EQUATION

by

Thomas A. Perrigo

A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Arts

in

Economics

Department of Economics
University of Nevada, Las Vegas
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This paper is an empirical study of the spatial neutrality of economic incentives and the equivalency of push-pull factors of net migration into Clark County, Nevada. These issues are examined in the context of the Economic-Demographic Forecasting and Simulation Model developed by Regional Economic Modeling Incorporated. Specifically, two implicit assumptions found in the net migration equation in the REMI model are tested.

First, a test is performed to determine if pooling migration data across regions is appropriate. That is, are potential migrants in nearby areas more responsive to differentials in expected income than potential migrants in more distant areas? Using IRS Area to Area Migration data, place to place equations by regions and a pooled migration equation are estimated. We expect that region-specific characteristics (economic, amenity, and cultural) cause significant differences in migration across regions, which would bring into question the validity of using a single equation that pools migration data across regions.

The results of this first test suggests that pooling migration data across regions is imposing restrictions that
weakens the explanatory power of the model.

Second, we test whether net migration into Clark County is influenced more by changes in expected income in Clark County, or by changes in expected income in the region of origin. The IRS Area to Area Migration data is again used to estimate a pooled migration equation that considers independent variables (proxies for expected income) for both the origin and destination regions relative to the U.S.

The results of the push/pull tests provide evidence that the relative strength of push and pull factors as determinants of migration do differ. In addition, both push and pull factors are statistically significant and should be included in place-to-place migration models.
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Finally, I dedicate this accomplishment to the memory of my mother, Anne, who along with my father, Jim, is largely responsible for the person I am today.
CHAPTER 1

INTRODUCTION

Most people have economic and psychological investments in their place of residence, working hard to develop a sense of "home." However, there are numerous reasons why people will leave their homes and migrate to a new place. Some are in search of increased income in the form of higher wages or increased employment opportunities. Others are more interested in improving the quality of life by moving to areas that have a more "optimal" combination of geographic, social, or economic characteristics. Regardless of the individual motivating factors, migration is a utility maximizing behavior.

The causes of migration have been the center of debate among researchers for years. Some have argued that economic differentials are the primary factor motivating migration, while others argue it is the quality of life factors along with the stage in a person's life cycle that influence individual migration decisions. Still others argue from a macro standpoint that the demographic and economic characteristics of sending and receiving regions should be considered when developing migration models.

These are all important points that should be taken
into consideration when developing explanatory migration models. Reliable migration models are valuable tools to decision makers because they provide information on the potential labor supply, population growth, and the demographic characteristics of a region.

Most economists rely primarily on economic data for the explanatory variables to estimate migration models. Unfortunately, detailed migration data do not exist. Therefore, most migration models are estimated using regionally pooled data sets. This impairs the ability of researchers to capture the importance of distance and region-specific differentials in their migration models.

This paper examines the appropriateness of using pooled data in a net migration equation. The specific model examined is the net migration equation found in the "Economic-Demographic Forecasting and Simulation Model," of the Regional Economic Modeling Incorporated (REMI). This model was chosen because it is used extensively in academia, public agencies, and private research organizations, and is one of few regional models that integrate economic and demographic processes.

The migration equations are estimated using the Internal Revenue Service Area to Area Migration and County Income data. This data set provides estimates of place to place migration flows. The results indicate that there are random and structural differences affecting migration flows
across regions. Thus, models that use pooled data ignore significant region-specific characteristics that influence migration, which may produce inaccurate results. Also, the explanatory power of migration models that use pooled data is significantly less than that of models using place to place migration flows. Furthermore, the differential characteristics of regions causes migrants to consider both push and pull factors separately. Therefore, migration models should allow for both push and pull factors to have varying influence on the decision to migrate.
Variations in migration patterns over time have a major impact on, and in turn are impacted by, regional economic, cultural, and social conditions. Large flows of people out of an area can impact the tax-base, which affects the ability of the local government to provide basic infrastructure needs such as road repair, trash removal, park maintenance, and water and sewer services. Also, services such as police, fire, ambulance, and even welfare programs can be adversely impacted. On the other hand, regions experiencing rapid increases in population caused by in-migration may have difficulty keeping up with the demand for the same infrastructure and services mentioned above.

Migration is also a key factor in determining the local labor supply, which in turn has significant implications for regional economic development efforts and employment growth.¹ Regions must have a qualified labor force in order to attract industries or allow existing industries to grow.

¹For a discussion about the effects of economic development on migration and the labor force, see: Bartik, Timothy J., 1991, "Who Benefits from State and Local Economic Development Policies?", W.E. Upjohn Institute for Employment Research, Kalamazoo, MI.
Industries may be skeptical of relocating to a region without an adequate supply of workers unless they can rely on in-migrants to fill their demand for workers. Regions that have difficulty attracting workers will likewise have difficulty attracting industries. On the other hand, some regions experience a positive net migration that exceeds jobs-growth. For example, in the early 1990's Clark County Nevada experienced one of the fastest employment growth rates in the nation. Paradoxically, the unemployment rate actually increased at times during this period. This is the result of in-migrants adding to the local labor force so that the supply of labor out-paced the demand for labor.

The causes of migration into Clark County could be amenity differentials, economic differentials, or more likely, a combination of the two. If these factors are positive relative to other regions, they could act to "pull" potential migrants to Clark County. The consequences of the rapid in-migration and therefore the excess labor supply could be to hold wages steady and induce industries to move to Clark County, thereby creating economic growth.

On the other hand, this rapid growth in population could put pressure on the local infrastructure which may detract from the attractiveness of the area for both industries and potential migrants. This could slow the rate
of in-migration and also increase out-migration (or return migration) as a result of decreasing amenity and economic differentials. This out-migration would be the result of "push" factors that influenced individuals to move away from Clark County.

Because of the effect migration has on a regional economy, it is important for researchers to understand migration and its causes and consequences. A comprehensive understanding of the determinants of migration is necessary to develop models to predict migration patterns. This will allow decision makers in the public and private sectors to mitigate the impacts of changes in the population and labor supply caused by migration.

Earlier work focused on developing modified gravity-type models. Gravity-type models, within the context of population change, assume that migration is directly related to the size of the population in the origin and destination areas, and inversely related to the distance between the potential origin and destination. Other variables such as relative wage rates and relative employment opportunities may be included as "proxies for various arguments of individual utility functions." Gravity models imply that distance is a serious deterrent to the decision to migrate.

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4 Ibid., p. 398.
The decline in migration rates with increased distance is said to be caused by increased transportation costs (those costs associated with the physical movement of a household) and increased psychic costs. Psychic costs are defined as costs associated with moving to a new, unfamiliar area, leaving behind friends and family. Psychic costs increase with distance because as individuals move farther from home they may have less information about the new area, and they may feel isolated due to less contact with family and friends.

Many factors influence the decision to migrate, creating conditions that may "push" individuals away from a region, or "pull" individuals to a region. Factors that influence out-migration (push) from a region may not be the same as those that determine in-migration (pull). Early studies concluded that the demographic characteristics of a region are the primary push factors, whereas the economic characteristics of a region are the primary pull factors. This relationship may be most prominent in metropolitan areas. However, recent studies have concluded that, depending on their stage in the life cycle, migrants into amenity rich non-metropolitan areas are willing to trade

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5Ibid., pp. 404-406.


income for quality of life.\textsuperscript{8}

Economists tend to concentrate on migration as being a function of differential economic conditions across regions, such as wage rates and employment opportunities, which offer strong incentives to potential migrants.\textsuperscript{9} People will respond to these signals, and migrate to regions that offer better economic opportunities. Some economists postulate that this migration will contribute to per-capita income convergence across regions.\textsuperscript{10} Thus, migration serves as a labor market equilibrating device. However, empirical evidence has revealed persistent differentials in wage rates and employment opportunities between regions over time that would seem to dispute the existence of regional equilibrium in the labor market.\textsuperscript{11} Although the empirically observed movement of migrants is in the right direction, the magnitude of migration has not been sufficient to eliminate the differences in economic opportunities and income across


\textsuperscript{9}Economists have taken this position for years based on economic theory, as J.R. Hicks put it "...differences in net economic advantages, chiefly differences in wages, are the main causes of migration" [105, 1932, p. 76] Taken from Greenwood, Michael, "Research on Internal Migration in the United States: A survey," p. 530.


the regions over time.\textsuperscript{12}

Alternatively, persistent wage and employment opportunity differentials, it is argued, may be a result of cost of living differentials such as housing prices, etc., and/or quality of life conditions such as: parks, schools, cultural amenities; or place characteristics such as: climate, geology, distance from other attractive areas, and the distance of migration from origin to destination. These amenities (or lack thereof) may serve to compensate households for differentials in real wage rates and employment opportunities.\textsuperscript{13} Thus, region-specific amenities may be an important part of the potential migrants decision matrix, along with expected income and their stage in the life-cycle. That is, given the information about the regional amenities, expected income, and the stage of the life-cycle, individuals will maximize their expected

\textsuperscript{12}Larry Sjaastad discusses some possible reasons for the correlation between in and out migrants, and points out the importance of the different factors motivating in and out migrants as contributing to persistent income differentials. "The Costs and Returns of Human Migration," pp. 80-93. See also, Greenwood, Michael, "Research on Internal Migration in the United States: A Survey," pp. 82-83.

utility. Recently, more attention has been given to life-cycle and investment in human capital considerations. Individuals maximize expected utility by comparing the present value of future income flows to the cost of migration. This theory predicts that young people in general are more likely to migrate due to the greater expected economic returns resulting from a longer career span. Older people are less likely to move because they do not have as much time to realize greater economic returns than the cost of moving. Households with strong ties to the community, such as households with school age children and two wage-earner households are also less likely to migrate.

People with greater investments in education are more likely to move because the expected pay-off is greater due to more potential for career advancement by relocating with the same company or a new company. Also, more educated

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14 Michael Greenwood discusses work done in this area by Graves (1980) and Graves and Linneman (1979) as important because: "1) The emphasis is on individual decision making at a microeconomic level; 2) the approach takes an equilibrium perspective and assumes reasonably perfect information and mobility, which is in contrast to the common practice of labor economists to view migration as resulting from individual attempts to arbitrage away utility gains that exist in a world of disequilibrium; and 3) the approach emphasizes the importance of location-specific amenities, which follows from its emphasis on equilibrium notions." "Human Migration: Theory, Models, and Empirical Studies," Journal of Regional Science, 1985, p. 530.

15 Ibid., pp. 527-529

individuals are better able to gain access to information, but more importantly, they are better able to process available information resulting in improved decision making that increases economic returns to migration.\textsuperscript{17}

Depending on the stage of the life-cycle, migrants will impact communities differently. For instance, older more established migrants who are in the prime of their earning potential may add to the tax-base because of increased earnings. However, these same migrants may create more demand for services such as schools, police protection, libraries, cultural centers, etc. Younger migrants may not be as economically established, and unable to contribute as much to the tax-base, but will still impact the labor supply, affecting wages and economic development. Younger migrants may also increase demand for public goods and services, further burdening the ability of the community to provide services to its residents.

The above discussion points out some of the important considerations that create unique challenges for researchers when attempting to develop migration models. Because of limited data, most models are unable to capture the psychic costs of migration. Thus, some research includes distance as a proxy for psychic costs. Faced with the measurement difficulties of psychic costs, most empirical research of

\textsuperscript{17}Greenwood, Michael, "Human Migration: Theory, Models, and Empirical studies, p. 533.
migration, however, does not account for psychic or monetary costs. That is, they do not include a distance variable in their model.

These migration models rely on relative economic variables such as wages and employment opportunities to fully explain the migration flows. For example, a common variable included in migration models is expected income, which assumes that individuals will make the decision to migrate into a region based upon the probability of increased earnings. However, most migration models consider the wage rate in one region relative to the national average wage rate.

By excluding a measure of "distance", these models create a potential problem. For illustrative purposes, let's say person A lives 100 miles from city X. Person B lives 1,500 miles from city X. Suppose that city X has a fully employed labor force and a major project is planned that will create new jobs. This will cause wages to increase, and will create higher income and employment opportunities in city X relative to the national average. Because these models assume that individuals will migrate to city X without any regard to distance, individuals A and B will be just as likely to move to city X, despite the fact that person B must travel 1,400 miles further than person A.

The problem arises if there is no potential labor supply within a certain range of city X, outside of which
few people are willing to migrate. Suppose person A lives in a region with a relatively small and fully employed labor force that isn't capable of supplying the increased demand for labor in city X. Suppose further that not enough individuals in person B's region are willing to travel the 1,400 miles to city X. This model would then understate migration into city X, thereby overestimating the potential labor supply. Wages would then have to increase to a level that would induce individuals to migrate the 1,400 miles or more to city X, or cause individuals from nearby regions who are currently employed to leave their jobs.

An alternative approach would be to define regional labor market areas and devise a weighting mechanism based on the distance between regions, the size of the regional labor force, and region-specific differentials. This system would work to equilibrate the labor market within the defined area through migration within the area first, and then induce migration between regional labor market areas with less consideration being given to more distant markets. For example, defining a labor market area that includes Southern California and Clark County would appropriately consider the migration flows within this area first, and then look to other regions for potential migrants.

Because of the importance of the labor market to

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regional and national economies, developing migration models is a necessary part of building large-scale multi-regional economic models. Indeed, one of the many challenges regional economists face is developing accurate migration models that can be used in regional economic models.

Large-scale economic models are frequently used for forecasting, policy analysis, and economic impact analysis. Input-Output (I/O) models are a popular tool used to determine regional multipliers and to analyze the impact of various government policies and large-scale development projects or public-works projects on local economic conditions. But even the most commonly used I/O model, IMPLAN, does not properly consider the causes and effects of migration in the labor market and thus the economy. IMPLAN simply assumes a fully employed labor force in the region, and meets increased demand for labor (due to an exogenous demand shock) totally through in-migration.

Another commonly used regional model is the Economic-Demographic Forecasting and Simulation (EDFS) model developed by Regional Economic Modeling Inc. (REMI). The REMI model is preferred by many regional analysts because it is a dynamic general equilibrium model, similar to the large-scale national macro-economic models. The model provides a year by year estimate of impacts beyond the

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current period until the impact of a shock is fully absorbed. This is a great improvement over I/O models that provide a one-period estimate of impacts. In addition, the REMI model accounts for the labor sector by incorporating a demographic module that estimates the supply of labor based on the structure of the local population, migration, and economic conditions in the region and the U.S.\(^2\)

\(^2\)Ibid., pp. 232-236.
CHAPTER 3

OVERVIEW OF THE REGIONAL ECONOMIC MODELING INCORPORATED ECONOMIC-DEMOGRAPHIC FORECASTING AND SIMULATION MODEL

The REMI model is widely used by applied economists for: forecasting and planning; economic development; transportation; energy and natural resources; taxation, budget, and welfare; United States policies; and environmental policies. This model is popular because it is a dynamic econometric model that provides much more information than I/O models, according to Roger Bolton "The Massachusetts model (an early version of the multi-region REMI model) is a world apart in complexity, reliance on interindustry linkages, and modeling philosophy." While it's true that the dynamic nature of the model offers improvements in forecasting capabilities over I/O models, it's also true that "if the econometric portions of the model are suppressed, the model becomes a sophisticated

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version of an input-output model."

One of the advantages of the REMI model is the demographic module that integrates economic and demographic processes. This becomes even more significant when modeling a booming region like Clark County, as indicated by Treyz, Rickman and Shao (1992), "the demographic-economic interaction becomes pronounced for rapidly growing or declining regions, and models that ignore this interaction may be misleading."

The REMI model estimates natural changes in population using a cohort algorithm that predicts the amount of births and deaths that will occur. The local labor supply is then determined, before migration, by applying labor force participation rates to the estimated population. REMI then incorporates a net migration equation that interacts simultaneously with the economic part of the model to estimate net migration based on specific economic conditions in the region relative to the nation, i.e.; the relative wage rates (RWR) in the region; the relative wage mix (RWM, the industry mix effect on wages); and the relative employment opportunities (REO) in the region.

Chart 1 outlines the endogenous linkages in the REMI model. The interaction of population and migration with the

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economic portions of the model is easily discernible. Migration will alter the demographic structure of the population, and migrants compete with the local labor force for jobs. These economic-demographic processes allow the user to simulate population changes due to changing economic conditions.²⁴

Chart 1. MAJOR ENDOGENOUS LINKAGES IN THE REMI MODEL

Reliable time-series data on migration that can be extrapolated into the future is unavailable, thus, researchers use theoretically-derived models to estimate

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²⁴Treyz, George, D. S. Rickman, G. Shao, "The REMI Economic-Demographic Forecasting and Simulation Model," pp. 221-253
economic migration from which forecasts can be developed.\textsuperscript{25}

Therefore, the REMI net migration equation is based on accepted theoretical principles, and assumes that economic migration is a function of expected income (EY) in the destination region relative to the U.S., and relative amenities (A). That is

\begin{equation}
NECM_j = g \left( \frac{EY_j}{EY^u}, \frac{A_j}{A^u} \right)
\end{equation}

and

\begin{equation}
\left( \frac{EY_j}{EY^u} \right) = g \left[ \frac{ER_j/NLF_j}{ER^u/NLF^u}, \frac{\sum_i (E_i/E_j \cdot W_i / (RYS_j/YPS_j))}{\sum_i (E_i/E_j \cdot W_i / (RYS^u/YPS^u))}, \frac{\sum_i (E_i/E_j \cdot W_i^u)}{\sum_i (E_i/E_j \cdot W_i^u)} \right]
\end{equation}

Where

\begin{itemize}
\item NECM = Net economic migrants to region j
\item A = amenity level
\item EY = expected income
\item ER = the civilian employment adjusted for place-of-
\end{itemize}

\textsuperscript{25}Treyz, George, et al., "The Dynamics of U.S. Internal Migration."
residence

NLF = the potential labor force
E_i = employment in sector "i"
W_i = wage rate in sector "i"
RYD = real disposable income
YP = personal income

The superscripts u and j represent the U.S. and region j, respectively. The first argument in equation 2 is the relative employment opportunity (REO), which is simply the employment rate in region j relative to the employment rate in the U.S. If region j has a higher employment rate than the U.S., then REO will support in-migration. The second argument in equation 2 is the relative wage rate (RWR), adjusted for the regional wage mix. Employment by industrial sector in region j is multiplied by the wage rate in region j (W_j) in the numerator, and also by the U.S. wage rate in the denominator. This would increase the RWR in Clark County because E_{i}/E_j is heavily weighted towards the hotel industry, and the wage rate in the hotel industry is higher in Las Vegas than the U.S. average. The final argument in equation 2 is the relative wage mix (RWM), which is the regional mix effect on wages. The industrial employment mix in region j (E_{i}/E_j, which is heavily weighted

towards the hotel industry in Clark County) is multiplied by the U.S. wage rate \( (W_{ui}) \) in the numerator. This would tend to lower the RWM in Clark County because the average hotel industry wage rate is lower in the U.S. than in Clark County, and the U.S. industrial mix is weighted more heavily towards higher paying industries than the hotel industry.

As previously mentioned, by taking the above explanatory variables relative to national averages, the REMI model assumes that individuals will migrate to a region if the expected income in that region is greater than expected income in the nation; irrespective of the expected income differentials between the current residence and the potential region. The REMI model is not alone in assuming that net migration may depend on economic variables relative to the nation. Weighting these variables by nearby regions that provide the greatest potential for migration is not a common practice.\(^2\) Again, these models implicitly assume that distance is not an influencing factor in migration flows.

To estimate the net migration equation, the REMI model uses time-series-cross-section pooled data. This approach was partially based on the lack of adequate time series data. However, it is partially based on the belief that the same theoretical framework is useful in every state. Treyz and Stevens originally developed the REMI multi-regional

model from the Massachusetts model by assuming that behavior
does not change across the nation, stating "there is little
reason to believe that economic units in one region of the
country have measurably different behavioral characteristics
from those in another." In a discussion on their
philosophy behind the Massachusetts model, Bolton states
that "given short time series and other data problems, ..... estimates from pooled regressions of all states should be
used and their advantages outweigh the disadvantages of
imposing the same specification on all states."  

A pooled regression of all states implicitly assumes
that individuals will be motivated to move to Clark County,
Nevada from the state of Maine by the same economic factors
as individuals from southern California. Recently, however,
it has been suggested that "one might consider defining a
labor supply potential variable." That is, defining a
"regional" labor market and thus a potential labor supply.
Defining an appropriate "regional" labor market is most
likely to overcome the potential problem of eliminating
distance from the migration model (an implicit assumption of
the REMI model). For example, southern California and Clark
County could be defined as a regional labor market. In this
case, the large migration flows from southern California to

28 Ibid., pp. 510-512.
29 Ibid., p. 511.
30 Ibid., pp. 513-514.
Clark County, Nevada, might provide a useful weighting mechanism for modeling Clark County migration.\textsuperscript{31} For the remainder of this paper, the concept of a "potential regional" labor market will be utilized within the REMI conceptual framework.

\textsuperscript{31}Treyz has even suggested a multi-regional model that would make migration flows between states endogenous. Ibid., p. 514.
CHAPTER 4

METHODOLOGY

This section examines the appropriateness of the two implicit assumptions made by REMI's net migration equation. Part A discusses a test of the assumption that pooling data across regions produces accurate results. By pooling the migration data, REMI assumes that region-specific differentials do not enter into the migrants decision process, and therefore distance is also not a factor. Part B examines the relative influences of push and pull factors on the net migration flows from other regions of the U.S. to Clark County, Nevada.

The empirical tests on the above mentioned assumptions are conducted using regression analysis with the Internal Revenue Service (IRS) Area to Area Migration Data as the dependent variable. The dependent variable for each region is normalized by dividing the migration flow by the labor force of the region of origin. The independent variables have been extracted directly from the REMI model.

Test on Pooling Migration Data

The REMI model uses carefully developed migration data for the dependent variable, derived using a cohort
component model and census data. This time-series migration
data is then pooled across regions. Because migrants are
pooled across regions, labor is assumed to be perfectly
mobile, and in-migration will continue as long as a region
has positive economic differentials relative to the U.S. By
pooling the migration data across regions, the REMI
migration equation assumes the U.S. is one regionally
relevant labor market.

To test this assumption three models will be estimated.
The first model, equation 3, uses pooled data thereby
assuming the coefficients on the right-hand side variables
are equal across regions. Therefore, equation 3 is the
restricted model because assumptions have been made about
the regression coefficients. Equation 3 is similar to the
net migration equation found in the REMI model, and operates
under the same assumptions. That is, equation 3 is
specified in semi-logarithm functional form, which implies
that some change in each of the independent variables is
necessary for migration to occur because the independent
variables enter into the equation multiplicatively rather
than additively.

(Eq. 3)

\[ NECM_{jt} = \alpha + B_1 \ln(RWR)_{jt} + B_2 \ln(RWM)_{jt} + B_3 \ln(REO)_{jt} + \sum_{j=1}^{12} D_j \]
Where

NECM = net economic migration into Clark County
RWR = wage rate in Clark County relative to region j
RWM = the effect on average pay of the industrial employment mix in Clark Co. relative to region j
REO = probability of getting a job in Clark County relative to region j
D = dummy variable representing origin regions

The dependent variable for this study (NECM) was developed by pooling the IRS data. The subscripts \( j \) and \( t \) denote the origin region and time, respectively. Dummy variables have been included in order to allow the intercept term to vary over cross-section units (12 origin regions). REMI assumes that the intercept term accounts for region-specific relative amenities, and specifying a fixed effects model that allows for different intercept terms (via dummy variables) captures the influence of various relative amenity levels for each region.

Given the costs of migration associated with the distance between regions, we would expect that economic differentials will have varying influences on the potential migrants decision. By specifying a pooled migration model, REMI assumes that the slope coefficients are constant across regions, which does not allow for structural differences. This will improve the efficiency of the model by increasing
the degrees of freedom, but may produce biased slope coefficients. Furthermore, the error term associated with regressions run for individual regions is expected to vary due to differences between regions which are not captured in the pooled model. For example, the error term may be capturing the effects of omitted variables in one region that are different from the effects captured in the error term in another region. Also, the errors associated with the collection of migration data may not be constant across regions.

An alternative specification to that of equation 3 would allow the coefficients of the explanatory variables to be estimated separately for each region of origin. Equation 4 is therefore estimated using net migration to Clark County, Nevada from each of the thirteen regions separately. Equation 4 is then considered to be the unrestricted equation because no assumptions are made about the regression coefficients. These coefficients are allowed to vary across regions.

\[(Eq. 4)\]

\[NECM_{jt} = \alpha_j + B_{yj} \ln(RWR)_{jt} + B_{yj} \ln(RWM)_{jt} + B_{yj} \ln(REO)_{jt}\]

The dependent and independent variables are the same as those defined above.

In order to test the validity of pooling the data across regions, an F-test is used to determine if the
coefficients in the restricted model (the pooled model, equation 3) should be allowed to vary across regions, as they are in the unrestricted model (equation 4). That is, we test for the equality of error sum of squares between the two models (equations 3 and 4).\(^\text{12}\)

If the results of the F-test are greater than the critical value, we will reject the null hypothesis and conclude that pooling data across regions is inappropriate because equation 3 restricts the coefficients to be equal across regions when in fact they are not. Alternatively, if the null hypothesis is true, we can conclude that the coefficients in equation 4 are equal to the coefficients in equation 3. This would imply that the model could be specified as a single equation using pooled data, and that the restrictions in equation 3 are not hurting the explanatory power of the model.

The proposed model tests the assumption that the error variance across the two equations is constant in addition to testing the constancy of the slope coefficients. Unfortunately, we are unable to determine if the variance is a function of structural differences captured in the slope coefficients, or random noise in the error term. Therefore, to test the robustness of the results from the F-test, a third model is specified that assumes a constant error

variance. The specification will allow for structural differences across origin regions by estimating a separate intercept and slope for each region. This will expose those region-specific differences which are structural in nature as determined by the slope coefficient. Equation 5, which also uses pooled data, is a "fully interactive" model that allows both the slope and the intercept of each region to vary.

\[
\text{NECM}_{jt} = \alpha_0 + \beta_{1j} \ln(RWR)_{jt} + \beta_{2j} \ln(RWM)_{jt} + \beta_{3j} \ln(REO)_{jt} + \sum_{j=1}^{12} \alpha_j(D)_{jt} \\
+ \sum_{j=1}^{12} \gamma_j(RWR_j \ast D)_t + \sum_{j=1}^{12} \delta_j(RWM_j \ast D)_t + \sum_{j=1}^{12} \theta_j(REO_j \ast D)_t
\]

To test that the net migration is not significantly influenced by region specific variables, the coefficients of the interaction terms will be examined. We would expect the coefficients on the interactive terms to be statistically significant, which suggests that the slope of the regression line is not constant across regions. If the coefficients are not significantly different from zero, the change in the slope of the regression line associated with a change in
region would not be statistically significant enough to disqualify a model that uses pooled migration data.

**Effects of Push vs. Pull Factors**

As discussed earlier, there are many factors that contribute to the relative strength of push and pull factors. For instance, early research concluded that the economic conditions of a region (one that has a relative advantage in wages and employment opportunities) are strong pull factors, whereas the demographic characteristics (such as the average education, age, and family size of the population) are the primary push factors. More recently, studies have argued that the relationship between amenities and quality of life considerations will compensate individuals for lower expected income. Therefore, a combination of factors may serve as push and pull factors, but some amenity rich regions will attract or "pull" individuals, regardless of the expected income. The tests outlined below will determine if the economic push factors are equal to the economic pull factors, without untangling the complex combination of amenity, life cycle, and other factors that enter into the migration decision.

---


To test the relative importance of economic conditions of the origin versus those of the destination on the flow of net migration, three models will be examined. The first model, equation 6, allows for differential strength of economic factors between the destination and the origin.

(Eq. 6)

\[
NECM_{\alpha} = \alpha + \beta_{1c} (RWR)_{\alpha} + \beta_{2c} (RWM)_{\alpha} + \beta_{3c} (REO)_{\alpha} \\
+ \beta_{4j} (RWR)_{jt} + \beta_{5j} (RWM)_{jt} + \beta_{6j} (REO)_{jt}
\]

The independent variables include the same economic measures from both origin and destination areas. All variables are taken relative to the U.S., and subscripts c and j denote Clark County and region j, respectively.

The second model, equation 7, restricts the coefficients of origin variables to be equal to those of destination variables, with opposite sign. That is, the restricted model assumes that a change in relative economic differentials in the origin region will have the same effect as a change in relative economic conditions in the destination region.

(Eq. 7)

\[
NECM_{cr} = \alpha + \beta_{1c} (RWR_{\alpha} - RWR_{jt}) + \beta_{2c} (RWM_{\alpha} - RWM_{jt}) \\
+ \beta_{3c} (REO_{\alpha} - REO_{jt})
\]
An F-test, using equations 6 and 7, will be performed to test whether the coefficients of corresponding origin and destination factors are jointly equal. That is, the null hypothesis that $\beta_{1c} = \beta_{4j}$, $\beta_{2c} = \beta_{5j}$, and $\beta_{3c} = \beta_{6j}$, jointly, is tested.

The third model, equation 8, examines the equality of corresponding origin and destination factors for each independent variable separately.\(^5\)

(Eq. 8)

\[
NECM_{\alpha} = \alpha + \beta_{1c} (RWR_{\alpha} - RWR_{j}) + \gamma_{1} RWR_{jt} + \beta_{2c} (RWM_{\alpha} - RWM_{j}) + \gamma_{2} RWM_{jt} + \beta_{3c} (REO_{\alpha} - REO_{j}) + \gamma_{3} REO_{jt}
\]

If the coefficients $\gamma_{1}$, $\gamma_{2}$, and $\gamma_{3}$ in equation 8 are statistically significant, we can conclude the existence of differential impact for the corresponding variables between the origin and the destination.

A migration time series data set that has been developed by the IRS is used to test the models outlined in the previous section. The IRS Area to Area Migration Data is a relatively new time-series data set that includes gross migration flows between regions. The IRS reports gross migration flows by county or by state. The data set is developed by matching the social security number (SSN) of the primary taxpayer in one year to the previous year. If the SSN's match, the county of residence for the primary taxpayer is compared between years to determine if the taxpayer is a migrant or a non-migrant. If the county of residence changes between the two returns, the taxpayer is considered an out-migrant from the county of residence in the previous year and an in-migrant to the county of residence in the current year.

In order to increase the sample size, exemptions (taxpayers and their dependents) claimed on IRS income tax returns are included. However, the final data set does not include all migrants because the exemptions may change from
year to year due to births, deaths, marriages, and dependents no longer being counted as exemptions.

The IRS reports migration for the counties that comprise .5% or more of total migration during any given period, and aggregates the remaining counties by census region (North East, North Central, South, and West).

For this study, the county data set is used which reports gross in-migration and gross out-migration flows between counties for the 1979 - 1990 time period, though data for 1984 were missing. Since there are few counties with observations in each year, the counties are aggregated to the state level. The result is nine states with observations in each year. The remaining states are aggregated to the regional level. Therefore, the final data set used for the empirical tests in this paper includes nine states and four regions.

Table 1 shows gross migration flows between Clark County, Nevada, and the thirteen regions (for the sake of continuity, hereafter states and regions will be defined as regions) for the 11 year period (1979 - 1990, 1984 is missing). It is interesting to note that out-migrants to the midwest, northeast, Colorado, and Hawaii are a much smaller percentage of in-migrants from those same regions compared to regions in the south and west (there are more than twice as many in-migrants as out-migrants for the midwest, northeast, Colorado, and Hawaii).
Table 1
Total IRS Migration* For The Period 1979 - 1990
To Clark County, NV From Thirteen Regions

<table>
<thead>
<tr>
<th>Region</th>
<th>In- Migration</th>
<th>Percent of Total</th>
<th>Out- Migration</th>
<th>Percent of Total</th>
<th>Net Migration</th>
<th>Percent of Total</th>
<th>Ratio of In to Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>103,198</td>
<td>22.18</td>
<td>59,689</td>
<td>20.24</td>
<td>43,509</td>
<td>25.55</td>
<td>1.73</td>
</tr>
<tr>
<td>Midwest</td>
<td>80,735</td>
<td>17.35</td>
<td>36,350</td>
<td>12.32</td>
<td>44,385</td>
<td>26.06</td>
<td>2.22</td>
</tr>
<tr>
<td>West</td>
<td>76,170</td>
<td>16.37</td>
<td>59,509</td>
<td>20.18</td>
<td>16,661</td>
<td>9.78</td>
<td>1.28</td>
</tr>
<tr>
<td>South</td>
<td>66,456</td>
<td>14.28</td>
<td>51,671</td>
<td>17.52</td>
<td>14,785</td>
<td>8.68</td>
<td>1.29</td>
</tr>
<tr>
<td>Northeast</td>
<td>43,264</td>
<td>9.30</td>
<td>21,057</td>
<td>7.14</td>
<td>22,207</td>
<td>13.04</td>
<td>2.05</td>
</tr>
<tr>
<td>Arizona</td>
<td>29,853</td>
<td>6.42</td>
<td>18,370</td>
<td>6.23</td>
<td>11,483</td>
<td>6.74</td>
<td>1.63</td>
</tr>
<tr>
<td>Nevada</td>
<td>19,727</td>
<td>4.24</td>
<td>20,392</td>
<td>6.91</td>
<td>(665)</td>
<td>-0.39</td>
<td>0.97</td>
</tr>
<tr>
<td>Utah</td>
<td>13,397</td>
<td>2.88</td>
<td>8,141</td>
<td>2.76</td>
<td>5,256</td>
<td>3.09</td>
<td>1.65</td>
</tr>
<tr>
<td>Texas</td>
<td>9,602</td>
<td>2.06</td>
<td>7,291</td>
<td>2.47</td>
<td>2,311</td>
<td>1.36</td>
<td>1.32</td>
</tr>
<tr>
<td>Colorado</td>
<td>8,115</td>
<td>1.74</td>
<td>2,762</td>
<td>0.94</td>
<td>5,353</td>
<td>3.14</td>
<td>2.94</td>
</tr>
<tr>
<td>Florida</td>
<td>7,039</td>
<td>1.51</td>
<td>5,669</td>
<td>1.92</td>
<td>1,370</td>
<td>0.80</td>
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</tr>
<tr>
<td>Hawaii</td>
<td>3,909</td>
<td>0.84</td>
<td>1,921</td>
<td>0.65</td>
<td>1,988</td>
<td>1.17</td>
<td>2.03</td>
</tr>
<tr>
<td>New Mexico</td>
<td>3,775</td>
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<td>2,109</td>
<td>0.72</td>
<td>1,666</td>
<td>0.98</td>
<td>1.79</td>
</tr>
<tr>
<td>Totals</td>
<td>465,240</td>
<td>100.00</td>
<td>294,931</td>
<td>100.00</td>
<td>170,309</td>
<td>100.00</td>
<td>1.58</td>
</tr>
</tbody>
</table>

*Internal Revenue Service (IRS) Area to Area Migration and County Income Data.

Figure 1
Clark County IRS Migration Flows*
This may be the result of fewer migrants returning to those regions, possibly due to economic differentials and a reluctance to move back to their region of origin because of colder climates or the greater distances involved. Households that migrate greater distances have pondered their migration decision more intensely and they have more invested in the move (this may be most prevalent in Hawaii, which has high monetary and psychic costs associated with moving). Thus they are less likely to return. Also, in-migrants to Clark County may relocate to closer southwestern states with warm climates and economic opportunities, increasing the number of out-migrants to the west and south.

Figure 1 shows in, out, and net migration for 1978 - 1990. Out-migration appears to be fairly constant, thus net migration is driven by in-migration. Also, in-migration was relatively stable until 1985, thereafter it increased continuously. Out-migration has been stable since 1981, it wasn't until 1985 that in-migration began growing, causing net migration to become increasingly positive, and Clark County to become one of the fastest growing counties in the U.S.

In what follows, the IRS migration data has been aggregated to reflect the four census regions. This will facilitate analysis of the IRS migration data and also allow us to compare it to the REMI models estimated migration and an estimate of migration using census data (calculated as
census population 1990 minus census population 1980 minus births plus deaths). Tables 2, 3, and 4 and figures 2, 3, and 4 show the time series data for in, out, and net migration, respectively by the four regions. Figure 2 reveals that in-migration is fairly constant from all regions except the west, where in migration began growing in the mid '80's, increasing from 19,348 in 1985 to 41,066 in 1990. Figure 3 shows that out-migration to all four regions has been fairly constant during the entire decade. Figure 4 shows a general pattern of increasing net migration in the late '70's, declining in the mid '80's, and leveling off in the late '80's for all regions except the west, where large increases in net migration occurred in the late '80's.

Table 5 shows total net-migrants between 1980 and 1990. The REMI estimate (generated by the REMI 1993 EDFS-53 Nevada model) of migration is fairly close to the census estimate. The IRS estimate of migration is considerably less than the other two, 154,350 compared to 229,900 for REMI and 225,610 for the census. The IRS data is only a sample of migration flows and does not capture all migrants (see above discussion on the IRS data set). Therefore it is necessary to look at the year to year changes in the IRS data compared to the REMI data in order to determine the appropriateness of using the IRS data for evaluating the REMI estimates.

As figure 5 shows, the data sets move together, and appear to be positively correlated. Table 5 reports the
<table>
<thead>
<tr>
<th>Year</th>
<th>Midwest</th>
<th>Northeast</th>
<th>South</th>
<th>West</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>6,385</td>
<td>5,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1980</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
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<tr>
<td>1981</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
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<tr>
<td>1982</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1983</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1984</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1985</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1986</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1987</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1988</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1989</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
<tr>
<td>1990</td>
<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
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<tr>
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<td>4,420</td>
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<tr>
<td>1994</td>
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<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
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<tr>
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<td>5,892</td>
<td>18,503</td>
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<td>4,420</td>
<td>5,892</td>
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<td>4,420</td>
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<td>1999</td>
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<td>18,503</td>
<td>35,599</td>
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<td>7,503</td>
<td>4,420</td>
<td>5,892</td>
<td>18,503</td>
<td>35,599</td>
</tr>
</tbody>
</table>

*Internal Revenue Service (IRS) Area-to-Area Migration and County Income Data.*
Table 3
Total IRS Out-Migrants by Region

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>2,084</td>
<td>2,084</td>
<td>3,144</td>
<td>3,272</td>
<td>3,478</td>
<td>3,127</td>
<td>3,535</td>
<td>3,570</td>
<td>3,744</td>
<td>3,939</td>
<td>4,374</td>
</tr>
<tr>
<td>Northeast</td>
<td>1,555</td>
<td>1,555</td>
<td>2,334</td>
<td>2,239</td>
<td>2,270</td>
<td>2,077</td>
<td>1,857</td>
<td>1,761</td>
<td>1,815</td>
<td>1,692</td>
<td>1,903</td>
</tr>
<tr>
<td>South</td>
<td>3,887</td>
<td>3,887</td>
<td>5,799</td>
<td>6,676</td>
<td>6,629</td>
<td>6,275</td>
<td>6,317</td>
<td>6,161</td>
<td>5,649</td>
<td>6,095</td>
<td>7,257</td>
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<tr>
<td>West</td>
<td>12,115</td>
<td>12,115</td>
<td>16,930</td>
<td>17,456</td>
<td>17,080</td>
<td>17,152</td>
<td>16,392</td>
<td>15,337</td>
<td>15,132</td>
<td>15,767</td>
<td>17,418</td>
</tr>
</tbody>
</table>

*Internal Revenue Service (IRS) Area to Area Migration and County Income Data.

Figure 3
Total IRS Out-Migrants by Region

---

**Note:** The table and graph data represent the total number of IRS out-migrants by region from 1979 to 1990, as reported by the Internal Revenue Service (IRS). The data includes migration trends across different regions, with the Midwest, Northeast, South, and West regions being specifically highlighted. The graph visually illustrates the number of migrants over the years, showing trends and patterns in out-migration.
Table 4
Total IRS Net Migrants by Region

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>4,701</td>
<td>4,701</td>
<td>4,545</td>
<td>4,091</td>
<td>3,039</td>
<td>3,539</td>
<td>3,426</td>
<td>4,211</td>
<td>3,691</td>
<td>4,085</td>
<td>4,356</td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>2,865</td>
<td>2,865</td>
<td>2,445</td>
<td>2,035</td>
<td>1,364</td>
<td>810</td>
<td>1,232</td>
<td>1,692</td>
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<tr>
<td>South</td>
<td>2,006</td>
<td>2,006</td>
<td>1,541</td>
<td>329</td>
<td>379</td>
<td>678</td>
<td>819</td>
<td>2,504</td>
<td>2,306</td>
<td>2,708</td>
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<tr>
<td>West</td>
<td>6,388</td>
<td>6,388</td>
<td>4,573</td>
<td>2,683</td>
<td>1,032</td>
<td>2,196</td>
<td>4,781</td>
<td>8,822</td>
<td>9,962</td>
<td>15,019</td>
<td>23,648</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15,960</td>
<td>15,960</td>
<td>13,104</td>
<td>9,138</td>
<td>5,814</td>
<td>7,223</td>
<td>10,017</td>
<td>17,229</td>
<td>17,863</td>
<td>23,853</td>
<td>34,149</td>
<td></td>
</tr>
</tbody>
</table>

*Internal Revenue Service (IRS) Area to Area Migration and County Income Data.

Figure 4
Total IRS Net Migrants by Region
Table 5
Total Net Migrants into Clark County, 1980 - 1990

<table>
<thead>
<tr>
<th>IRS*</th>
<th>REMI**</th>
<th>CENSUS***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Migrants (in '000's)</td>
<td>154.35</td>
<td>229.9</td>
</tr>
<tr>
<td>10 yr Growth of Net Migrants</td>
<td>113.97%</td>
<td>42.07%</td>
</tr>
<tr>
<td>IRS to REMI Correlation Coefficient</td>
<td>0.812</td>
<td></td>
</tr>
</tbody>
</table>

*Internal Revenue Service (IRS) Area to Area Migration and County Income Data.
**Regional Economic Modeling Inc. (REMI), Multi-Region EDFS-53.
***Migration estimated from census data from Summary Tape File 1, U.S. Department of Commerce, Bureau of the Census. (1990)

Figure 5
IRS Net Migrants* vs. REMI Net Migrants**
correlation coefficient (.812), as further evidence that the REMI data is positively correlated with the IRS data. Since the data sets have similar patterns, the IRS data should provide a good proxy for evaluating REMI's migration equation.

Empirical Results

Pooling Migration Data Test Results

Table 6 shows the results of equation 3, where the data have been pooled across thirteen regions. As discussed above, the pooled equation is similar to the REMI net migration equation, except it assumes that individuals from different "regional" labor markets rather than from the entire nation will respond similarly to economic differentials. The pooled model, like the REMI model, also assumes that distance is not a factor.

The R-squared reported for the pooled model is only .26, whereas the R-squared for each region in the thirteen region model is generally much higher (see results of thirteen region model, Table 7, below). The low Durbin/Watson (D.W.) statistic (.75), could be an indication of positive serial correlation in the error term, but the interpretation of the D.W. statistic becomes convoluted with pooled data.36

36The pooled equation was estimated again using first differences, which eliminated the serial correlation but did not substantially alter the outcome compared to the model estimated without using first differences. Therefore, in order to be consistent with the 13 region
<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.0018303</td>
<td>(4.03)</td>
</tr>
<tr>
<td>ln RWR*</td>
<td>-0.0008819</td>
<td>(-4.2)</td>
</tr>
<tr>
<td>ln RWM*</td>
<td>0.006234</td>
<td>(2.47)</td>
</tr>
<tr>
<td>ln REO*</td>
<td>0.0022165</td>
<td>(1.38)</td>
</tr>
<tr>
<td>D2**</td>
<td>0.0001162</td>
<td>(.41)</td>
</tr>
<tr>
<td>D3**</td>
<td>6.20E-05</td>
<td>(.19)</td>
</tr>
<tr>
<td>D4**</td>
<td>0.000443</td>
<td>(1.55)</td>
</tr>
<tr>
<td>D5**</td>
<td>-0.0001103</td>
<td>(-.26)</td>
</tr>
<tr>
<td>D6**</td>
<td>8.63E-05</td>
<td>(-.13)</td>
</tr>
<tr>
<td>D7**</td>
<td>-0.0002322</td>
<td>(-.85)</td>
</tr>
<tr>
<td>D8**</td>
<td>-0.0005992</td>
<td>(-2.24)</td>
</tr>
<tr>
<td>D9**</td>
<td>-0.0014791</td>
<td>(-4.20)</td>
</tr>
<tr>
<td>D10**</td>
<td>-6.75E-05</td>
<td>(-.22)</td>
</tr>
<tr>
<td>D11**</td>
<td>9.16E-06</td>
<td>(.02)</td>
</tr>
<tr>
<td>D12**</td>
<td>-0.0003329</td>
<td>(-1.21)</td>
</tr>
<tr>
<td>D13**</td>
<td>-0.0002433</td>
<td>(-.84)</td>
</tr>
</tbody>
</table>

Sum of Squared Residuals 0.0000439, N = 143

R-squared = 0.26, F = 2.96, D.W. = .75

t-statistics in parentheses

*ln RWM = Relative Wage Mix, ln RWR = Relative Wage Rate, ln REO = Relative Employment Opportunity.

**D2-D13 are dummy variables for intercept terms of cross section units, a dummy variable for California has been omitted.
The coefficient on the relative wage rate is negative, which would indicate that an increase in wages in Clark County relative to other regions would decrease net migration. However, given a high standard error, the relative wage rate is not statistically different than zero. Thus, the relative wage rate may not be a factor in determining migration into or out of Clark County.

The coefficient on the relative wage mix is positive and significantly greater than zero. This would indicate that the industrial mix effect on wages in Clark County has a positive effect on migration. In other words, an increase in the relative wage mix would increase net migration. Two possible explanations for this relationship are as follows. The Clark County tourism market is comprised primarily of the Hotel industry and the Amusement and Recreation industry, which are combined by the Nevada Employment Security Department to form the Hotel, Gaming and Recreation industry (HGR). As HGR grows, it becomes more competitive and necessarily more sophisticated. This creates demand within the HGR industry for workers with higher education.

Furthermore, it is not the intent of this paper to perfect a migration model. Although the existence of serial correlation may be causing the slope coefficients to be biased, the magnitude of the effects is assumed constant across models. Therefore, given the nature of the data and the limited degrees of freedom in the individual place to place equations, no attempt will be made to correct for serial correlation in the pooled models or the push/pull models.
and skill levels in higher paying occupations, such as management and computer systems analysis. These jobs will create positive net migration because the traditional HGR jobs are in occupations requiring lower skill and education levels, and thus the Clark County labor market is not well equipped to supply these workers. Furthermore, HGR has been moving away from low skill level labor intensive jobs in the casinos in favor of computer games and slot machines. This further erodes the demand for lower skill level occupations.

Secondly, the increase in higher paying occupations in the HGR industries is creating demand for workers in the higher paying service industries such as medical, business services, etc. This will also create positive net migration, as the Clark County labor pool is not equipped to supply these higher education and skilled professional workers.

The coefficient on REO is also positive which indicates that an increase in employment opportunities in Clark County relative to other regions will increase net migration. Although it is not statistically significant at the .10 level, it is significant enough to warrant further discussion. It is no secret to most of the U.S. that Clark County is one of the fastest growing cities in the nation. Most individuals equate population growth with economic opportunity in the form of employment. Therefore, we would expect Clark County to have a positive and favorable
relative employment opportunity. Furthermore, the Clark County economy was booming during the late 1980's and early 1990's while the rest of the nation was experiencing a mild recession or at best slow growth (especially the weak economy in southern California), which would further contribute to an increasing relative employment opportunity.

Another possible reason that the relative employment opportunity has a positive effect on net migration may be the relative size of the tourism industries (HGR). The HGR industries are highly visible and information pertaining to jobs growth and wages is readily available in other regions. Thus, migrants may be responding primarily to signals in the HGR industries, reflected in the relationship between the relative employment opportunity and net migration. Furthermore, the same glitz and glamour and opportunity for the "big bucks" associated with gaming that attracts tourists may also be attracting potential migrants to jobs in the HGR industries, as well as to Clark County.

The dummy variables represent intercept shifts for each of the regions except California. The coefficients on the dummy variables are mixed, but mostly negative. This would indicate, within the REMI theoretical framework, that Clark County is an amenity poor region. However, the dummy variables may be capturing other effects (including possible biased coefficients), and also they are mostly not statistically different from zero.
Table 7 shows the results of equation 4, which is the net migration equation for each of thirteen regions. The intercept term is significant in seven of the thirteen regions, which could be an indication of the effect of amenity differentials. The relative wage mix is significant in six of thirteen regions, all of which are in the west. This indicates that the relative wage mix has a significant contribution to the decision to migrate into Clark County from nearby regions, but may not from more distant regions. The relative wage rate is significant in only three western regions, which could indicate that relative wages are not a strong influence on the migrants decision. The relative employment opportunity, on the other hand, is significant in eight of the thirteen regions. This would indicate that migrants into Clark County place more emphasis on the probability of securing a job rather than on the relative wage they can expect to earn.

Over-all, nearby regions are more likely to have significant coefficients on the relative wage rate and the relative employment opportunity, while distant states are more likely to have significant coefficients only on the intercept term and the relative employment opportunity. These regional differences lend support to the theory that defining regionally relevant labor markets is important to estimating economic migration. Furthermore, distance may indeed play an important part in determining the assignment
Table 7
Regression Results for Thirteen Regions, Dependent Variable is Net Migration

<table>
<thead>
<tr>
<th>Region</th>
<th>Constant</th>
<th>ln RWM*</th>
<th>ln RWR*</th>
<th>ln REO*</th>
<th>Sum of Squared Residual</th>
<th>F</th>
<th>D.W.</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>0.0010552</td>
<td>0.0026413</td>
<td>-9.39E-05</td>
<td>0.0092172</td>
<td>5.96E-08</td>
<td>17.98</td>
<td>2.01</td>
<td>0.89</td>
</tr>
<tr>
<td>Arizona</td>
<td>0.0049388</td>
<td>0.0294159</td>
<td>0.0063996</td>
<td>0.0113574</td>
<td>9.09E-07</td>
<td>13.19</td>
<td>1.71</td>
<td>0.85</td>
</tr>
<tr>
<td>Colorado</td>
<td>0.0032774</td>
<td>0.0184084</td>
<td>0.0050739</td>
<td>-0.001426</td>
<td>1.47E-07</td>
<td>20.50</td>
<td>1.75</td>
<td>0.90</td>
</tr>
<tr>
<td>Utah</td>
<td>0.0086979</td>
<td>0.0369024</td>
<td>0.0026774</td>
<td>0.01115</td>
<td>5.69E-07</td>
<td>49.66</td>
<td>3.05</td>
<td>0.96</td>
</tr>
<tr>
<td>Texas</td>
<td>0.003095</td>
<td>0.0011213</td>
<td>0.0003781</td>
<td>0.0010809</td>
<td>3.03E-09</td>
<td>43.98</td>
<td>2.25</td>
<td>0.95</td>
</tr>
<tr>
<td>Hawaii</td>
<td>0.005719</td>
<td>0.0065434</td>
<td>0.0018368</td>
<td>0.0017375</td>
<td>3.09E-07</td>
<td>1.16</td>
<td>1.20</td>
<td>0.33</td>
</tr>
<tr>
<td>New Mexico</td>
<td>0.000668</td>
<td>0.0076739</td>
<td>0.0078706</td>
<td>0.0031656</td>
<td>5.42E-07</td>
<td>2.80</td>
<td>1.80</td>
<td>0.55</td>
</tr>
<tr>
<td>Florida</td>
<td>0.0001016</td>
<td>2.28E-04</td>
<td>-7.79E-05</td>
<td>0.0007224</td>
<td>6.96E-09</td>
<td>2.43</td>
<td>1.57</td>
<td>0.51</td>
</tr>
<tr>
<td>Nevada</td>
<td>0.000562</td>
<td>-0.102974</td>
<td>-0.074533</td>
<td>0.0070079</td>
<td>4.52E-06</td>
<td>11.55</td>
<td>2.01</td>
<td>0.83</td>
</tr>
<tr>
<td>Northeast</td>
<td>0.0001448</td>
<td>3.25E-04</td>
<td>0.002613</td>
<td>0.0007288</td>
<td>6.37E-10</td>
<td>22.54</td>
<td>2.63</td>
<td>0.91</td>
</tr>
<tr>
<td>Midwest</td>
<td>0.0003136</td>
<td>0.0033444</td>
<td>-3.12E-04</td>
<td>0.0010303</td>
<td>1.24E-09</td>
<td>5.30</td>
<td>1.97</td>
<td>0.69</td>
</tr>
<tr>
<td>South</td>
<td>0.0001343</td>
<td>4.03E-04</td>
<td>9.56E-05</td>
<td>0.0006838</td>
<td>7.22E-10</td>
<td>6.14</td>
<td>2.73</td>
<td>0.72</td>
</tr>
<tr>
<td>Rest of the West</td>
<td>2.197E-05</td>
<td>-0.000319</td>
<td>-0.000188</td>
<td>0.0001927</td>
<td>1.84E-09</td>
<td>0.48</td>
<td>2.15</td>
<td>0.17</td>
</tr>
</tbody>
</table>

\( t \)-statistics in parentheses, \( N = 11 \) for each region.

*ln RWM = Relative Wage Mix, ln RWR = Relative Wage Rate, ln REO = Relative Employment Opportunity.
of regions to a labor market. Also, the R-squared is much higher for the majority of the regional regressions than the R-squared on the pooled equation, and serial correlation does not appear to be a problem as indicated by a Durbin-Watson close to two for each region. These arguments, based on the results of the regressions run using equations 3 and 4, begin to build the case that pooling the data across regions is introducing constraints that may be effecting the outcome of the model.

To test this statistically, an F-test is applied to determine if the assumptions made on the coefficients in equation 3, the pooled model, are causing them to vary significantly from the coefficients calculated using equation 4, the unrestricted model. The appropriate F-test is:

\[
F_{12K, 13 \cdot (N-K)} = \frac{(ESS_R - \sum ESS_{UR}) / 12K}{\sum ESS_{UR} / 13 \cdot (N - K)}
\]

(Eq. 9)

where \(N\) is the number of data points, \(K\) is the number of variables (including intercepts) in each equation, \(13 \cdot (N-K)\) is the total degrees of freedom in the unrestricted model. ESSur is the aggregate of the sum of the squared residuals for each region. ESSr is the sum of the squared residuals from the pooled equation.
The results of the F-test are reported in Table 8. The computed $F$ is greater than the critical $F$ distribution at the 1 percent level. Therefore, we reject the null hypothesis and conclude that the coefficients are not equal. Thus, pooling the data across regions is imposing restrictions on the equation that may result in an incorrectly specified model.

These results indicate that there are significant differences in the determinants to migration across regions, and therefore individual place to place equations should be estimated for each region in order to allow the error variances and slope coefficients to vary. The source of those differences could be random (as captured in the error term) or structural (as indicated by the slope coefficients). The F-test does not distinguish between those regional differences that are random from those that are structural. Therefore, equation 5 assumes that the error variances are constant, and the remaining "shift" in the coefficients is due to structural differences across regions.

Equation 5 is a fully interactive model, with California serving as the control region. The coefficients on the remaining 12 regions represent a shift in the intercept or slope coefficients from the intercept and slope coefficients in California. If these coefficients are statistically significant, we can conclude that there are
Table 8
Results of F-test

<table>
<thead>
<tr>
<th></th>
<th>ESSur*</th>
<th>ESSr**</th>
<th>Computed F 48, 91</th>
<th>Critical F 48, 91, 1% significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net-Migration</td>
<td>7.07E-06</td>
<td>4.39E-05</td>
<td>9.88</td>
<td>1.59</td>
</tr>
</tbody>
</table>

*ESSur is the sum of the sum of the squared residuals in Table 7,  
**ESSr is the sum of the squared residuals in Table 6.
significant structural differences between California and the other regions in the determinants of migration to Clark County.

The results of equation 5 are reported in Table 9. The coefficients on the interactive terms in nearby western regions are more likely to be significant. This indicates that the difference in the slope associated with these regions is different from zero and should be allowed to vary from the control group, California. The western regions, California, Arizona, Colorado, and Utah, exhibit some of the same amenity characteristics as well as offering similar life styles. These regions also share common borders with Nevada, with the exception of Colorado. Thus, the results of equation 5 indicate that these regions should be considered separately, even though they are all in the west and would be expected to have similar determinants of migration.

The significant coefficients on the western regions is further evidence that economic differentials are more significant motivators to migration in nearby regions, and economic migration models should define potential labor supply regions accordingly. Also, the effects of economic differentials may become dampened with distance, which supports the argument that it is appropriate to apply less weight to distant regions. Furthermore, the R-squared is substantially better than the results from equation 3, which
Table 9
Regression Results for Fully Interactive Migration Model

<table>
<thead>
<tr>
<th>State</th>
<th>Constant</th>
<th>ln RWM*</th>
<th>ln RWR*</th>
<th>ln REO*</th>
</tr>
</thead>
<tbody>
<tr>
<td>California**</td>
<td>0.0010552</td>
<td>0.0026413</td>
<td>-9.39E-05</td>
<td>0.0092172</td>
</tr>
<tr>
<td>Arizona</td>
<td>0.0038836</td>
<td>0.0267746</td>
<td>0.0064934</td>
<td>0.0021403</td>
</tr>
<tr>
<td>Colorado</td>
<td>0.0022222</td>
<td>0.0157671</td>
<td>0.0051677</td>
<td>-0.010643</td>
</tr>
<tr>
<td>Utah</td>
<td>0.0076643</td>
<td>0.0342611</td>
<td>0.0027712</td>
<td>0.0019329</td>
</tr>
<tr>
<td>Texas</td>
<td>-0.000746</td>
<td>-0.00152</td>
<td>0.000472</td>
<td>-0.008136</td>
</tr>
<tr>
<td>Hawaii</td>
<td>-0.000483</td>
<td>0.003902</td>
<td>0.0019306</td>
<td>-0.00748</td>
</tr>
<tr>
<td>New Mexico</td>
<td>-0.000988</td>
<td>0.0050326</td>
<td>0.0079644</td>
<td>-0.006052</td>
</tr>
<tr>
<td>Florida</td>
<td>-0.000954</td>
<td>-2.41E-03</td>
<td>1.95E-05</td>
<td>-0.008495</td>
</tr>
<tr>
<td>Nevada</td>
<td>-0.000493</td>
<td>-0.105616</td>
<td>-0.074439</td>
<td>-0.002209</td>
</tr>
<tr>
<td>Northeast</td>
<td>-0.00091</td>
<td>-2.32E-03</td>
<td>0.0003552</td>
<td>-0.008488</td>
</tr>
<tr>
<td>Midwest</td>
<td>-0.000742</td>
<td>-0.002307</td>
<td>-2.19E-04</td>
<td>-0.008187</td>
</tr>
<tr>
<td>South</td>
<td>-0.000921</td>
<td>-2.24E-03</td>
<td>0.0001895</td>
<td>-0.008533</td>
</tr>
<tr>
<td>Rest of the West</td>
<td>-0.001033</td>
<td>-0.002961</td>
<td>-9.44E-05</td>
<td>-0.009024</td>
</tr>
</tbody>
</table>

R-squared = 0.88, F-value = 13.18, D.W. = 2.22
Sum of squared residuals 0.00000707, N = 143

*ln RWM = Relative Wage Mix, ln RWR = Relative Wage Rate, ln REO = Relative Employment Opportunity.
**Control Group
Highlighted t-statistics significant at .10 level or greater.
is the pooled equation which does not allow for changes in the slope coefficients.

**Push vs Pull Test Results**

Table 10 reports the results of the unrestricted push-pull model, equation 6. The coefficient on the relative wage mix is positive in Clark County. This indicates that the relative wage mix has "pulling" influence on the potential migrants decision to relocate to Clark County. That is, a more favorable wage mix in Clark County relative to the U.S. would have a positive influence on net migration into Clark County. What's puzzling is the positive coefficient on the relative wage mix in the region of origin. This implies that an improvement in the wage mix in the region of origin relative to the average U.S. wage mix would induce migration to Clark County. One possible explanation could be that as individuals in the origin region become employed in higher paying industries, they can better afford the costs associated with migration. Also, there may be some hidden effects caused by pooling the data.

The coefficient on the relative wage rate in Clark County is positive, which indicates that wages in Clark County relative to the U.S. act as a "pull" factor. Although the coefficient is not statistically significant at the .10 level or higher, it has the expected sign. The coefficient on the relative wage rate in the region of origin is significant and negative. This means that an
Table 10
Regression Results for Unrestricted Push vs. Pull Model

<table>
<thead>
<tr>
<th></th>
<th>RWM*</th>
<th>RWR*</th>
<th>REO*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clark County</td>
<td>0.0195508</td>
<td>0.0026037</td>
<td>0.004892</td>
</tr>
<tr>
<td></td>
<td>(6.02)</td>
<td>(1.12)</td>
<td>(2.07)</td>
</tr>
<tr>
<td>Region of Origin</td>
<td>0.0033011</td>
<td>-0.0028125</td>
<td>-0.0012312</td>
</tr>
<tr>
<td></td>
<td>(2.92)</td>
<td>(-3.90)</td>
<td>(-1.13)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0226099</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-3.80)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-squared = .33, F-value = 11.34, D.W. = .66, N = 143

*RW M = Relative Wage Mix, RWR = Relative Wage Rate,
REO = Relative Employment Opportunity.
Highlighted t-statistics significant at .10 level or greater.
increase in wages in the region of origin relative to the U.S. would decrease net migration into Clark County. Likewise, a decrease in wages in the origin region would increase net migration into Clark County. This is the relationship we would expect to find. Also, because the coefficients are nearly equal in absolute terms, a change in wages in Clark County would have nearly the same effect on net migration as a change in wages in the region of origin. However, the comparative t-statistics indicate that a change in the relative wage rate in the region of origin has a higher probability of causing a change in net migration in Clark County, while a change in the relative wage rate in Clark County may not have any impact (in a statistical sense).

The same relationships that characterize the relative wage rate hold for the relative employment opportunity. However, the coefficient on the relative employment opportunity in Clark County is greater in absolute terms than the coefficient on the relative employment opportunity in the region of origin. This indicates that the relative employment opportunity has a stronger influence as a "pull" factor than as a "push" factor. Also, the relative employment opportunity in Clark County is statistically significant, whereas the relative employment opportunity in the region of origin is not.
The relative strength of positive "expected income" differentials in Clark County appears to have a stronger influence on migration into Clark County than the "push" factors of other regions. This would indicate that economic migrants are more sensitive to changes in Clark County that would effect the probability of increased earnings than changes in the region of origin.

Table 11 shows the results of the restricted push-pull model, equation 7. The sum of the squared residuals from the equation is used to perform the F-test for the joint hypothesis discussed earlier. The F-test reported in Table 12 provides proof that the restrictions placed on the coefficients in equation 7 are unacceptable. The computed F-statistic exceeds the critical F-statistic, and therefore we can reject the null hypothesis. This signifies that all the coefficients of corresponding push and pull factors are not equal, and at least one of the factors has a differential impact.

Equation 8 tests for the existence of differential strengths in each of the variables in the push/pull model. The estimation of equation 8 is reported in Table 13. The significant coefficient on the relative wage mix in the region of origin (RWM_t) indicates that this variable has a differential impact as a push factor as it has as a pull factor.
### Table 11
Regression Results for Restricted Push vs. Pull Model

<table>
<thead>
<tr>
<th></th>
<th>RWMC\text{ Clark-origin}^*</th>
<th>RWR\text{ Clark-origin}^*</th>
<th>REO\text{ Clark-origin}^*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficients</td>
<td>0.0006288</td>
<td>0.0007724</td>
<td>0.0014207</td>
</tr>
<tr>
<td></td>
<td>(.52)</td>
<td>(1.05)</td>
<td>(1.22)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.001909</td>
<td>(0.70)</td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-value</td>
<td>.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.W.</td>
<td>.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T-statistics in parentheses

*RWM = Relative Wage Mix, RWR = Relative Wage Rate, REO = Relative Employment Opportunity.

### Table 12
F-test Results for Relative Strength of Push vs. Pull Factors

<table>
<thead>
<tr>
<th></th>
<th>ESSur*</th>
<th>ESSr**</th>
<th>Computed F 3, 136</th>
<th>Critical F 3, 136, 1% significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net-Migration</td>
<td>3.95E-05</td>
<td>5.84E-05</td>
<td>21.69</td>
<td>2.60</td>
</tr>
</tbody>
</table>

*ESSur is the sum of the sum of the squared residuals from equation 6.
**ESSr is the sum of the squared residuals from equation 7.
The above tests on pooling migration data and on effects of push vs. pull factors, based on our sample of data, offers evidence that the region-specific economic and amenity differentials, and possibly the demographic characteristics of the population should all be considered on a place by place basis. Migration models that fail to consider regions independently may suffer from biased coefficients and produce inaccurate representations of observed movements. These inaccuracies could be magnified when used to predict future migration patterns.

| Table 13 |
| Regression Results for T-test of Equality of Push vs. Pull Factors |

<table>
<thead>
<tr>
<th>*RWMc-j</th>
<th>*RWMjt</th>
<th>*RWRc-j</th>
<th>*RWRjt</th>
<th>*REOc-j</th>
<th>*REOjt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficients</td>
<td>0.0195508</td>
<td>0.0228519</td>
<td>0.0026037</td>
<td>-0.000209</td>
<td>0.004892</td>
</tr>
<tr>
<td>(6.02)</td>
<td>(6.58)</td>
<td>(1.12)</td>
<td>(-0.09)</td>
<td>(2.07)</td>
<td>(1.39)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.02261</td>
<td>(-3.80)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared= .33, F-value = 11.34, D.W. = .66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* RWM = Relative Wage Mix, RWR = Relative Wage Rate, REO = Relative Employment Opportunity.
Highlighted t-statistics significant at .10 level or greater.
CONCLUSION

There are numerous complex factors that ultimately determine the magnitude and direction of migration flows. As with any relationship involving the interaction of human behavior, developing explanatory migration models is exceedingly difficult. The REMI net economic migration model is founded on the premise that individuals migrate in order to maximize expected income. The existence of a strong relationship between migration and the opportunity for economic advancement is intuitively appealing, and has been successfully argued in empirical studies for years. However, it has also been shown that there is a strong relationship between the decision to migrate and distance, psychic costs, amenities, demographic characteristics, and other non-monetary factors that effect the quality of life.

Because the REMI model uses pooled, cross-section time-series data, it implicitly assumes that region-specific differentials in economic opportunities and amenities are not important to the decision to migrate. The use of pooled data also implies that the behavior of economic migrants is not significantly different from one region to another.

By comparing a pooled migration equation to individual place to place migration equations, this paper has provided some evidence that region-specific characteristics are
important to the migration decision. The specific causes of these regional differences have not been determined in this paper. However, based on the wealth of studies completed on this subject, one can reasonably assume that a combination of the distance between regions, along with the demographic and amenity characteristics of the origin and destination regions, accounts for the different levels of importance assigned to economic factors. As has been argued in this paper, the region-specific characteristics are significant determinants of migration. The explanatory power of migration models can be greatly enhanced by accounting for these regional characteristics.

The second conclusion that can be drawn from this paper is that not all economic variables have the same impact in pulling or in pushing migrants to or from a region. That is, migrants may not consider origin push factors as intensely as they consider destination pull factors.
BIBLIOGRAPHY


