# EXPLAINING THE HISPANIC PARADOX: AN EXAMINATION OF THE OUT-MIGRATION EFFECT ON THE HEALTH COMPOSITION OF THE MEXICAN IMMIGRATION POPULATION

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September 2006

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## ABSTRACT

Immigrants have been consistently observed to enjoy more favorable health/mortality outcomes than natives, even after controlling for SES and other demographic and social factors. Explanations for the immigrant advantage in the U.S. fall into three major categories: (1) data artifact, (2) acculturation/assimilation, and (3) selectivity in migration. The hypothesis concerning migration selection is that the foreign-born appear healthier because of a greater tendency for healthier persons to immigrate, and reversely, a greater tendency for unhealthy persons to emigrate (commonly referred to as the "salmon bias" hypothesis). Using March Supplements of the annual Current Population Survey (CPS) and the matched NHIS-NDI files, this paper examines health disparities between Mexican immigrants and Mexican Americans, and explores the possibility that emigration among Mexican immigrants residing in the United States affects the assessment of their general health situation. A new approach for estimating emigration rates based on the matched CPS files is applied in the analysis. The results generally support the salmon bias hypothesis, showing higher emigration rates for unhealthy foreign-born Mexicans compared with their healthy counterparts. This pattern holds for young and old Mexican immigrants, but not among people at working ages. Gender differences show that the out-migration effect is stronger among female Mexican immigrants compared to males. Duration of residence does not appear to be related to health selectivity in emigration independent of age. Although the selectivity effect appears small when observed over the course of a single year, the effect cumulates over time, reaching levels that may produce the relatively high level of health observed among Mexican immigrants who remain living in the United States.

# INTRODUCTION

Studies on racial/ethnic health disparities have documented a controversial issue in the field of Hispanic health (Markides & Eschbach, 2005). Despite the fact that Hispanics are disadvantaged in terms of socioeconomic (SES) well-being, they experience favorable or fair mortality and health outcomes relative to the non-Hispanic white population. This phenomenon is known as the Hispanic Paradox. Statistical evidence of the paradox has been revealed by scholars using various data sources (Markides & Eschbach, 2005). The final mortality data for 2002 reported by the National Vital Statistics Reports (2004) showed that the age-adjusted death rate for the Hispanic population is 24.9 percent lower than the rate for the non-Hispanic white population and 43 percent lower than the rate for the non-Hispanic black population. Although findings in Hispanic mortality profiles consistently reinforce the paradox, data on other health indicators, activity limitation, and self-reported health have not yielded strong evidence (Markides & Eschbach, 2005; Hummer et al., 2004). Whether such mortality advantages among Hispanic populations are real has been examined from a variety of perspectives. Some researchers claim that any understanding of race/ethnic disparities in health and mortality patterns must take into account the immigrant composition in each race/ethnic group (Bean et al., 2004). It is especially crucial for the study of Hispanic populations because a relatively large proportion of the Spanish-origin population is foreign-born (Kestenbaum, 1986).

Below I first review the main findings and consistent patterns revealed by previous studies on the Hispanic Paradox, with an emphasis on the immigrant composition, and evaluate various hypotheses that are proposed to explain the paradox, such as data artifact, acculturation/assimilation, and selective migration. This study primarily focuses on the

examination of selective out-migration hypothesis, a relatively new but less examined explanation. Relevant assumptions and characteristics of the out-migration hypothesis are reviewed thoroughly, followed by discussions of whether selective out-migration exists in Mexican immigrant population and how it impacts the evaluation of the remaining Mexican immigrant population's health. I choose Mexican immigrant population as the object because (1) the existence of such an epidemiologic paradox originated from Markides and Coreil's findings on the health of Southwestern Hispanics, mostly Mexican Americans (Markides & Coreil, 1986); (2) the out-migration selection effect may be more likely to be observed in the case of Mexican immigrants due to frequent circular migration (Abraido-Lanza et al., 1999).

# BACKGROUND

## The Hispanic Paradox

As noted before, Markides and Coreil (1986) first revealed the epidemiologic paradox that was repeatedly suggested in other research findings. In terms of infant mortality, overall life expectancy, mortality from cardiovascular diseases and major cancers, Mexican Americans exhibited a relatively favorable health status that was more comparable with non-Hispanic whites, rather than non-Hispanic blacks who shared similar socioeconomic disadvantages. By the 1990s, the paradox was found not only in Mexican Americans, but as well as in other Hispanic populations (Markides & Eschbach, 2005). Hispanics, while displaying modestly lower elderly mortality than non-Hispanic whites, exhibited higher levels of self-reported fair and poor health, slightly lower levels of active life expectancy, and a higher level of activity limitations than non-Hispanic whites (Hummer et al., 2004).

On the other hand, the evidence began to show that compared with native populations, foreign-born populations presented better health/mortality outcome. Foreign-born populations residing in the United States have been found experiencing overall lower mortality rates relative to native-born populations in the 1986 Kestenbaum's mortality report by nativity. Based on vital statistical data, his report also noted that compared to Natives, foreign-born populations presented lower death rates for various cause-of-death groupings, such as heart disease, other major cardiovascular diseases, cancer, and all other diseases (Kestenbaum, 1986). Afterwards, researchers found that the socioeconomic measures – education, occupation, income, marital status, and place of residence – contribute little to the observed nativity differentials in overall

mortality and in mortality from several major causes of death (Liao et al., 1998; Rogers, et al. 1996; Scribner, 1996; Singh, 2002; Sorlie et al., 1993).

Recently, increasing studies on the Hispanic Paradox noted that such health/mortality advantages were found in foreign-born Hispanic populations (Cho et al., 2004; Hummer et al., 2004; Palloni & Arias, 2004). Based on a series of parametric hazard models estimated on nine years of mortality follow-up data, Palloni and Arias (2004) suggested that the "Hispanic" mortality advantage is a feature found only among foreign-born Mexicans and foreign-born other Hispanics, and not among Cubans or Puerto Ricans. Similarly, Cho et al. (2004) examined subgroup differences in the health status of Hispanic adults, with particular attention to the influence of nativity. They found that for most Hispanic groups, immigrants reported better health than did the corresponding native-born ethnic groups. Regarding the inconsistence between the findings of the mortality and certain health indicators, the possible selective nature of the migration process, both in terms of immigration and emigration, may also have strong impacts on the patterns of health and mortality for Hispanics (Hummer et al., 2004).

### *Age Patterns*

Rosenwaike (1987) looked at the mortality differentials among three Hispanic immigrant subpopulations in the United States, as defined by national origin, i.e., Cuba, Mexico, and Puerto Rico. He found that mortality is relatively high among Cuban-born, Mexican-born and Puerto Rican-born adolescents and young adults, particularly males; while older migrants, despite their disadvantaged socioeconomic status, exhibit relatively low death rates from heart disease and cancer. Moreover, Jasso et al. (2004) observed a convergence in the prevalence rates between foreign-born and native populations at older ages. However, such mortality patterns across

different age groups are confounded with the duration of residence in the United States and age at arrival (Jasso et al., 2004). Liao et al. (1998) suggested that overall mortality is lower among Hispanics than among non-Hispanic whites, especially in the oldest age group. Among younger and middle-aged persons, the mortality of Hispanics is similar to or even higher than that of whites.

Although elderly Hispanics exhibited relatively low mortality rates, they reported higher prevalence of active limitations and self-rated fair and poor health status (Hummer et al., 2004). It could be explained that elderly Hispanics enjoy longer life span but experience poor health situation at old ages, and thus, could explain the lower mortality to some extent. Explanations for such ambiguities may also result from data misreporting, the reliability of measurement, and cultural difference in perceiving certain context (Hummer et al., 2004). More importantly, the possible selectivity in out-migration among elderly Hispanics that people emigrate from the US are less healthy than those remained could make this ambiguity plausible.

### *Duration of Residence*

Meanwhile, other researchers examined the relationships between health/mortality outcomes and the duration of residence in the United States. Cho et al. (2004) particularly examined the influence of duration of residence in the United States and they found that for most Hispanic groups, mortality advantages tend to be significantly smaller among immigrants with ten or more years of U.S. residence. Using the 1992-1995 National Health Interview Survey to examine the effect of immigrant status (both nativity and duration of residence in the United States) on the health of Asian and Pacific Islander adults, Frisbie et al. (2001) revealed consistent findings that immigrants are in better health than their US-born counterparts, but their health

advantages consistently decrease with duration of residence.

Some researchers also found that the effect of duration of residence is confounded with the effect of age. That is, the effect of duration on health relative to U.S.-born natives is not the same among immigrants of different ages. Cho and Hummer (2001) included an interaction term of age and nativity/duration of residence in the U.S. in multivariate regression analyses on the report of disabilities among the API population. The results demonstrated different health trajectories by duration of residence in the U.S. between older and younger immigrants. They found that in the comparison of predicted mobility limitations between natives and immigrants with 10+ years of residence in the U.S., although immigrants at working age exhibited lower risk of disabilities, older immigrants gradually converged to natives, and thereafter, around age 60, the direction of the gap in the probabilities reversed. Thus, duration of residence should not be assumed to have a constant effect on the advantageous health outcomes of immigrant regardless of biological age (Cho & Hummer, 2001).

## Three Major Hypotheses

Until now, researchers have proposed several possible explanations for the immigrant health advantages. They fall mainly in three categories: data artifact, acculturation, and selectivity in migration, each of which will be explained below.

*Data Artifact*

Recently, several studies have explored data errors that may account for the appearance of a Hispanic mortality advantage (Elo et al., 2004; Patel et al., 2004; Palloni & Arias, 2004). Palloni and Arias (2004) suggested three major problems concerning the quality of mortality data, including ethnic identification, misreporting of ages, and mismatches of records.

An under-estimate of Hispanic mortality rates due to ethnic identification occurs when the number of deaths (numerator) and the mid-year population (denominator) are derived from the Vital Statistics system and the census population enumeration, respectively. Ethnicity in denominators is usually self-identified, while ethnicity in numerators is reported by proxies, which usually causes an underreporting of Hispanic origin (Palloni & Arias, 2004). Data artifact may also emerge because some Hispanic populations tend to overstate their ages, particularly those who are older than age 55 or 60 (Palloni & Arias, 2004). The overstatements of ages (Palloni & Arias, 2004) make mortality at older ages appear lower than it actually is. Moreover, biases in Hispanic mortality can be created when the National Death Index (NDI) is used to identify deaths in samples that are pooled from survey data, such as the National Health Interview Survey (NHIS) data. Although matching the NDI database to survey respondents is considered as a standard method for ascertainment of mortality for a community cohort, it does not work perfectly for Hispanic populations (Patel et al., 2004). Conventionally, the NDI matches rely on the Social Security numbers, first and last names, middle initials, and father's surnames. However, due to the complex structure of Hispanic names and a relatively large number of undocumented Hispanic immigrants, traditional NDI matches usually lead to downward biases in Hispanic mortality (Patel et al., 2004; Palloni & Arias, 2004).

In 2004 Elo et al. calculated two sets of mortality estimates using different linked data

sources. Their first set of mortality estimates used vital statistics and census data that were corrected for an undercount of Hispanics in vital statistics and decennial census counts and the second set of estimates used Medicare data that were linked to application records for social security cards, maintained in Social Security Administration's NUMIDENT file that contains information of given names, surnames, maiden names, places of origin, and race/ethnicity. According to Elo et al. (2005), the strength of the Medicare-NUMIDENT data was in the quality of the data: the number of deaths of Hispanic origin and the population at risk come from a single source, which avoids the inconsistencies in the numerator and denominator data on age and ethnicity. Both mortality estimates presented the age- and sex-specific death rates for elderly non-Hispanic whites and Hispanics, including five Hispanic subgroups: persons born in Cuba, Mexico, Puerto Rico, other foreign countries, and the United States. They found that conventionally constructed death rates without adjustments for the underreporting of Hispanic origin on vital statistics and for the census undercount lead to underestimates of Hispanic mortality at older ages, and even with such corrections, Hispanic mortality estimates based on vital statistics and census data appear to be lower than the estimates from the Medicare-NUMIDENT data. Despite such errors in mortality data, however, immigrant health advantages still stand out suggesting other explanations for the disparities (Elo et al., 2004; Palloni & Arias, 2004).

### *Acculturation*

The hypothesis of acculturation originates from the hypothesized positive / buffering effect of immigrant healthy lifestyle behaviors, family and social networks, and ethnic community influence on immigrant individuals (Abraido-Lanza et al., 1999; Alba & Nee, 1997;

Landale et al., 1999; Palloni & Arias, 2004), which may protect immigrants from unhealthy lifestyles, provide social support, and actually, lead to better health and lower mortality.

In 1976 Marmot and Syme collected data from 3,809 Japanese-Americans in California who were classified according to the degree of retained traditional Japanese culture in order to test the hypothesis that social and cultural differences may account for the coronary heart disease (CHD) differences between Japan and the United States. They found that the most traditional group of Japanese-Americans had the CHD prevalence as low as that observed in Japan and the immigrant group that was most acculturated to Western culture had a three- to five-fold excess in CHD prevalence. Studies on infant mortality and low birth weight also support the idea that home culture and immigrant communities in the United States protects immigrants' health (Gordon-Larson et al., 2003; Weigers & Sherraden, 2001).

On the other hand, some researchers proposed the hypothesis of negative assimilation, which refers to the assimilation process that immigrant individuals are affected by less healthy American culture relative to immigrant cultures, such as obesity and risk behaviors, and thus immigrants experience a decline in health and mortality performance (Cho & Hummer, 2001; Frisbie et al., 2001; Jasso et al., 2004). It can be noted, however, that the adaptation and assimilation to the receiving countries may be followed by a series of enhancements OR deteriorations in various health outcomes of immigrants (Jasso et al., 2004). The negative assimilation theory helps explain the convergence of mortality patterns and health status observed between foreign and native-born populations along with the increasing duration of the residence in the United States, but does not explain why older immigrants tend to be healthier than younger immigrants.

### *Migration Selection*

Another possible explanation of the immigrant health advantage is related to migration selection. The literature of migration selection could be traced back to the 1950s, 1960s, and 1970s when several studies (Dunn & Buell, 1966; Keys, 1957; Marmot & Syme, 1976) examined the differentials in specific diseases between Japanese in traditional countries of migration and the population in Japan. It was found that selection effects existed, regardless of the impact of environment on health status. In the case of the migration process to the United States, being self-selected physically and psychologically, the immigrants are in overall better health and more competitive than average people in countries of origin, and even stronger than average people in countries of destination (Palloni & Arias, 2004). In this way, the immigrant populations undoubtedly have better health outcomes and mortality patterns relative to the native population.

In the analysis of healthy selection effects, according to Jasso et al. (2004), two factors should be taken into consideration: the geographic and economic distance between countries of origin and countries of destination, and the duration of residence in countries of destination. It is expected that migrants from countries that are geographically and/or economically closer to receiving countries are less selective, because of less competition or bravery needed. On the contrary, migrants traveling farther away from much poorer countries are usually observed to be more selective compared to those staying in home countries. The duration effect in the assimilation process is more complicated because it involves taking into account disparities of different ethnic groups migrating to the country of destination and the nature of the impact of the receiving countries' social and cultural contexts on immigrants. Usually, a negative correlation can be observed between immigrant health and the duration of residence.

Recently, a few researchers suspected a reverse causality in migration selection, which states that selection not only occurs at the threshold of moving into receiving countries, but also happens in out-migration. Given bad health or disappointing socioeconomic status and a certain period of residing in the receiving countries, less healthy immigrants may be more likely to move out of the United States and go to a third country or return home. Palloni and Arias (2004) use data from the Mexican Health and Aging Study (MHAS), which provide information on the migrant status of individuals who reside in Mexico and a limited migration history, to compare self-rated health status between those in Mexico and the United States. Although there are sample limitations, higher percentages of people in poor/fair health were found among those who moved back to Mexico relative to those who stayed in the United States. With these empirical findings, Palloni and Arias (2004) suggest that the foreign-born Mexican advantage can be attributed to return migration, or the "salmon-bias" effect.

## Studies on Emigration and Salmon Bias/Out-Migration Hypothesis

Research on the determinants of emigration of foreign-born populations is scant. Based on a few demographers' and economists' studies, factors accounted for the differential emigration flows of the current and future foreign-born populations emerge from economic, social network, political, and geographic perspectives (Borjas & Bratsberg, 1996; Duleep, 1994). First, the overall relative attractiveness of the country of origin in terms of its economic and social condition likely affects emigration. If a country of origin is less attractive than a country of destination, people from the sending country would be less likely to return home. Second, the probability of emigration would be reversely affected by social network that has been built in a country of destination by immigrants. It is also possible that the greater the presence of family

and friends in the United States, the less the likelihood that immigrants emigrate. Third, immigrants admitted as refugees tend to emigrate at a lower rate because of fear of political persecution (Warren & Peck, 1980; Jasso & Rosenzweig, 1990). If people migrate from a country that does not politically friend with a country of destination, the probability of emigration from the country of destination is low. Finally, geographic distance between a country of origin and a country of destination may negatively affect the probability of emigration. The farther a country of origin is, the greater the cost of return would be, and thus the lower the probability of emigration would be.

The total amount of emigration of the foreign-born population was estimated by the U.S. Census Bureau to have been about 195,000 per year during 1980-1990, a 47 percent increase from the estimated level during the 1970s (133,000 per year) (Ahmed & Robinson, 1994). A couple of prior studies have demonstrated levels and patterns of out-migration from the United States by demographic characteristics, such as sex, age, national origin, and period of residence in the United States. With regard to factors of age and time in the United States, Warren and Peck (1980) and Ahmed and Robinson (1994) reported similar findings that overall, the age pattern of emigration shows a declining trend by age for both males and females; and earlier cohorts tend to have lower emigration rates compared to the cohorts immigrating to the United States later. Warren and Peck (1980) presented emigration estimates that show relatively lower rates among males compared to females, which, however, disagree with Ahmed and Robinson's findings (1994). Ahmed and Robinson (1994) reported that overall, the male emigration rate of foreign-born populations was 11 percent and the female rate 9 percent during 1980-1990. Moreover, Ahmed and Robinson (1994) also demonstrated that emigration rates for Hispanics is the lowest, probably because of the same reasons for which Hispanic immigration is high (e.g.,

relative difference in economic and social conditions at origin and destination countries). Actually, this result has been criticized because of the high level of underenumeration of certain Hispanic groups. Van Hook et al (2006) estimate much higher emigration rates for Hispanics, which is consistent with the information coming from the Mexican Migration Project (Massey et al 2002). Moreover, geographic and economic differences between the original and receiving countries have impacts on emigration patterns as well. Take the example of Cuban and Mexican immigrants in the study of Abraido-Lanza et al. (1999). Due to political barriers, Cuban immigrants are less likely to return when they experience hardships surviving; all else equal, Mexican immigrants whose country borders the United States are more likely to make moves across the frontier. This suggests that it is more likely to observe higher emigration rates among immigrants from nearby countries than among immigrants from countries that are far away or that have political barriers for return.

Although the emigrant population represents a small population relative to the U.S. resident foreign-born population, it has been suggested that emigration has increased along with increases in immigration, and the loss may affect the assessment of demographic, economic, and social composition of the remaining foreign-born population (Ahmed & Robinson, 1994; Kraly, 1997). With regard to Hispanic Paradox, emigration may also play an important role if selective effects are strong. Migrants may go back to countries of origin following a period of unemployment and/or illness (Abraido-Lanza et al., 1999). It is possible that returning migrants experience similar health status or mortality risks as those remaining in the United States, resulting in a cancellation of the effects. However, we are more likely to observe differences between these two populations in various health outcomes and risks of dying (Jasso et al., 2004).

Researchers framed that immigrants are more likely to return when they get sick

(Abraido-Lanza et al., 1999; Palloni & Arias, 2004) and/or when the reality in countries of destination does not meet their expectations (Palloni & Ewbank, 2005). The relationship between health status and emigration patterns is primarily observed across different age intervals. Immigrants who are seriously ill may want to take advantage of family networks in home countries in order to get better physically and psychologically care, or they simply want to return to the places where they were born to die. This scenario may occur more often among older immigrants rather than younger groups. On the other hand, compared to recent-arrived immigrants, immigrants who have been staying in the United States for a relative longer period are more likely to obtain the permanent residence status and have the access to health insurance, and thus, less likely to emigrate because of health problems. Age effects on the emigration-health relationship are confounded with duration of residence in the United States.

The assessment of the out-migration hypothesis for the Hispanic Paradox is very limited because those who move back to the origins are not followed by any surveys conducted by the U.S. Thus, researchers are not able to assess whether the return migration affects the report of the mortality and health status of the remainders. An empirical study by Abraido-Lanza and colleagues (1999) found that neither salmon bias nor the healthy migrant hypothesis explains the Latino mortality paradox. The author suggested that other factors must be operating to produce the lower mortality among Hispanics. However, Palloni et al. (2004) reported different results. Using the Mexican Health and Aging Study (MHAS) that provides information on the migrant status of individuals who reside in Mexico and a limited migration history, Palloni et al. (2004) presented two sets of percentages of self-reported good health for return migrants and those who remained in the United States. Their findings showed that remaining Mexican migrants were marginally better in general health than Mexican migrants who emigrated from the United States

and returned. However, the authors noted that their findings should be viewed as suggestive but not decisive due to a number of limitations, such as the inconsistent datasets used for the comparison and mingled effects with the initial health selection in the immigration flow to the United States.

## General Health Measurement

The measurement of general health of Mexican immigrants and Native whites in the analysis is a single measure based on a survey question indicating five levels of health status (excellent, good, very good, fair, and poor), which is also designated as self-reported/rated health status. This simple measurement has been proved to be a powerful indicator of subsequent mortality experience (Idler & Benyamini, 1997). However, some researchers (Finch et al., 2002) claimed recently that self-reported health status is less predictive for subsequent mortality risk among Hispanic groups, and the use of self-reported health is even problematic for cross-ethnic comparisons in physical health, if acculturation effects are not controlled.

Nevertheless, the use of self-reported health status in this article does not present significant problems because it is primarily treated as a dichotomy variable to obtain percentages of people in good and poor/fair health. It is not applied to further evaluation of mortality risk. Moreover, the adjustments made to percentages of poor/fair self-reported health status are exclusively for comparisons of general health within Mexican population. The biases inherent in self-reports for different ethnicities are not of significance for interpreting the possible results.

# CURRENT INVESTIGATION

## Research Design

This study uses the 1996-2003 matched CPS March supplements to investigate the relationship between emigration and health among Mexican immigrants in the United States. Based on the observed health data from the matched CPS files, I first look at the comparison of the self-reported general health status among Mexican immigrants, Mexican Americans, and Native. I then detect and measure possible out-migration selection effects among Mexican immigrants. Because gender, age, and time in the U.S. have been shown in prior literature to be key factors related to both emigration and health (Abraido-Lanza et al., 1999; Palloni et al., 2004), I construct analyses separately by these three key factors. In this step, estimated annual emigration rates of Mexican immigrants both in good and poor health are used to estimate the general health status of Mexican immigrants who stay in the U.S. vis-à-vis those who emigrate. If emigration estimates of Mexican immigrants in poor health are different from estimates of those who stay, it indicates that selective out-migration exists and causes biases in the process of health assessment of remaining Mexican immigrants. Furthermore, if Mexican immigrants in poor health present higher emigration rates compared to those in good health, it suggested that the selective out-migration hypothesis explains part of the Hispanic Paradox.

This research moves beyond prior studies of the Hispanic Paradox in four ways. First, it focuses on the effect of out-migration. Due to data limitation, few studies have conducted examinations on the health assessment of out-migrants. This study uses health information reported in a single year by those who emigrate from the U.S. in the following year. In this way,

both emigration status and health data are guaranteed. Second, gender differences with regard to the out-migration pattern are addressed in this research. Studies on migration have shown great varieties in male and female migrations in terms of the motivation, the pattern, and the magnitude. It is the same for the study of out-migration that we have to explore in this field by different gender. Moreover, the relationship between health and out-migration may also vary for different gender. This study tries to thoroughly examine such gender differences. Third, this research evaluates the age-duration relationship in out-migration. These two factors have been profoundly interesting to researchers because the age-duration relationship could help further our understanding of immigrant populations' initial situation and how immigrants are assimilated into the US culture. Finally, this research presents cumulative out-migration effects using estimated emigration rates and observed health data. Because the emigrant population represents a small population relative to the U.S. resident population, the annual out-migration effect, if it exists, may be small too. However, whether such small effects on the assessment of the health of remaining Mexican immigrants can be neglected after a decade still remains unclear. This research helps answer this question.

## Hypotheses

Below, I develop several hypotheses based on prior literature on emigration and health patterns among immigrants.

**Hypothesis1 ─ The percentage of Mexican immigrants in poor/fair health are lower than that of Mexican Americans and Native whites, which indicates that Mexican immigrants do experience health advantage.**

This hypothesis is based on the consistent finding that immigrants enjoy a

health/mortality advantage over native populations after controlling for socio-economic status (Liao et al., 1998; Rogers, et al. 1996; Williams & Collins, 1995). It was also revealed in some other studies that such health/mortality advantages are accounted for by socio-economic status (Cho & Hummer, 2001; Hummer et al., 2000). In a recent study on self-reported health, Hummer and his colleagues (2004) found that older immigrants reported higher percents of poor and fair health relative to non-Hispanic whites, without controlling for income or poverty status (Hummer et al., 2004).

**Hypothesis 2 ─ Emigration patterns among Mexican immigrants, with regard to gender, age, and time in the United States, are: (1) higher rates for male than for females; (2) higher rates for younger immigrants than for older immigrants; (3) rates decline as time in the United States increases.**

This hypothesis is based on research showing that Mexican immigrant population tends to engage in frequent circular migration, particularly for men and working aged adults (Massey et al., 2002). Emigration rates for male and young Mexican immigrants are high because of the same reason for the relatively high immigration rates in such groups. In addition, research on emigration consistently shows that Mexican immigrants residing in the United States are less likely to emigrate as the duration of residence increases (Van Hook et al. forthcoming).

**Hypothesis 3 ─ The estimated emigration rates for Mexican immigrants in poor/fair health are higher than those of overall Mexican immigrants, thus indicating unhealthy selection in the process of emigration.**

A logical extension of this is that the percentages of Mexican emigrants in poor/fair

health are higher than for Mexican immigrants who remained in the United States. Hypothesis 3 is divided in three parts with regard to gender, age, and time in the United States.

***Hypothesis 3A —The unhealthy out-migration selection effect is stronger among females than male immigrants.*** In other words, the difference between the emigration rate of people in poor health and the overall rate among female immigrants are greater than the difference observed among male immigrants. This hypothesis is based on research showing that Mexican male immigrants are more involved in circular migration, in which the trip to Mexico is counted as emigration flows in this study (Durrand & Massey, 2005). For this group of emigrants, people in poor health are less likely to take such frequent trips. Because of a large number of healthy temporary emigrants, the unhealthy out-migration selection among Mexican male immigrants may not be as obvious as it is among females.

***Hypothesis 3B —The unhealthy out-migration selection effect is stronger among younger and older ages compared to immigrants falling in middle age intervals.*** In other words, the difference between the emigration rate of people in poor health and the overall rate among young and old immigrants are greater than the difference observed among immigrants of working ages. Comparatively speaking, young immigrants have limited access to health care and medical treatment and may therefore be more likely to return home country to seek this sort of assistance when they experience health problems. Old immigrants in poor health may also have strong desire to return home country, where they can benefit from family networks and psychological support. Moreover, note that both relatively low mortality rates and high percents of active limitation and poor/fair health exist in elderly Mexican American (Hummer et al., 2005). The strong unhealthy selectivity in elderly Mexican out-migration explains that unhealthy elderly Mexicans choose to emigrate and leave a favorable mortality record of their

counterparts remained in the US. Under the same health circumstance, however, immigrants of working ages may less likely to emigrate because of the ability to obtain available Medicare.

***Hypothesis 3C—The pattern of out-migration selection effect observed for different ages and gender does not vary with the duration of residence.*** Prior literature suggests that immigrant cohorts grow less healthy with time in the U.S. and the relationship is extensively explored under the assimilation hypothesis (Cho & Hummer, 2001; Frisbie et al., 2001; Jasso et al., 2004). To the degree that this pattern is driven by selective out-migration, this would mean that emigration selectivity for healthy people grows with increasing time in the U.S. However, there is no empirical evidence supporting the relationship between emigration selectivity and time in the U.S. I hypothesize that selection patters do not vary independent of age.

# DATA AND METHODOLOGY

## Data

To estimate foreign-born emigration rates for the late 1990s and early 2000s, I use the 1996-2003 Annual CPS Demographic Supplements, designated as the Annual Social and Economic Supplements beginning with March 2003. The supplements from this month offer several advantages over other months. The March Supplements contain a substantial range of socioeconomic and demographic information not in other months. The information needed to identify nativity and generational status appear in every monthly CPS since 1994, but only the March supplement contains the question on residence one year ago that we use to identify internal migrants and return immigrants. A further advantage of the March supplements is that the samples are larger than in other months. Since the mid-1970s, the March supplement has contained an oversample of Hispanics, a sampling scheme that effectively doubles the number of Hispanic households in the March Supplement. Beginning with the March 2002 CPS, the supplement has been expanded further by adding additional households from non-overlapping rotation groups in adjacent months. Since emigration is a relatively rare event, the larger samples provide more precise estimates. The analytical procedures for generating estimated emigration rates will be discussed below in detail.

To obtain non-follow-up rates that are essential for estimating emigration rates, the dataset of year $t$ is matched to the dataset of year $t+1$, using information of household identification number, individual sequence number, and state coding. The seven matched datasets (e.g., 96-97, 97-98, 98-99, 99-00, 00-01, 01-02, and 02-03) are then combined into one

dataset. The sample is restricted to population aged 15 and older, because data of self-reported health and residence one year ago of children under age 15 are not available in the CPS. Finally, I have a sample of 15,708 Mexican immigrants, defined as born in Mexico, and a sample of 22,613 Native whites, defined as born in the United States and race reported non-Hispanic white. More information about the sample characteristics is presented in the results section.

The National Health Interview Survey-National Death Index (NHIS-NDI) data are used to model the probability of dying in the U.S. for the foreign-born and natives. Conducted each year since 1957, the NHIS is an annual survey of individuals age 18 and older about health status, health care, and insurance coverage. Beginning with the 1986 sample, NHIS respondents were linked to the National Death Index (NDI) files (a data base of all deaths in the United States) in order to ascertain vital status and age at death. NHIS respondents are matched on a number of identifiers, including social security number, first and last name, father's surname, and month and year of birth. Details about the methodology and quality of matches are discussed in the NHIS documentation (NCHS 2000). The NHIS did not include a question on place of birth until 1989, so I use the 1989 through 1994 NHIS files, which are linked to the 1989-1997 NDI files.

## Measurement

### *The Estimated Emigration Rates*

A critical part for the analysis of the salmon-bias effect is to estimate emigration rates by age and health status. Official statistics on emigration from the United States are virtually non-existent (Van Hook et al., 2005). Early in the 1980s, some researchers have developed indirect methods for estimating foreign-born emigration (Ahmed & Robinson, 1994; Warren & Peck, 1980). The technique, referred to the residual method for estimating emigration in the

decade between two censuses, involves the comparison of two population figures: (1) the "expected" foreign-born population if no emigration had occurred during the decade; and (2) the resident foreign-born population at the end of the decade. The difference of the two figures would be the estimated number of emigrants among those arriving in the decade. Instead of applying the estimates from the residual method, I adopt the new approach recently developed by Van Hook et al. (2005) to estimate return migration. There are two advantages of using this approach: (1) the estimated emigration rates by Van Hook et al. (2005) and the percentage of persons in good health in this study come from the same data source; (2) The new approach is able to provide annual emigration rates (as opposed to 10-year rates), which are powerful for monitoring circulation migration featured by Mexican immigrants.

### *Basic Approach*[4]

Individuals in the March CPS in one particular year (year t) who do not appear in the following year's March CPS (year t+1) include those who died, internal migrants (who moved to other residences in the U.S.), emigrants who moved out of the country, and a residual group who cannot be matched for other reasons. The basic task is to subdivide the residual into emigration and residual-non-follow-up components. On the basis of prior knowledge and some assumptions about factors affecting the rates of internal migration, mortality, and non-follow-up, Van Hook et al (2006) used statistical methods to estimate the probability that non-matched adults age 15+ died in the U.S., moved internally, emigrated, and were not followed for other reasons. It is noted that individuals are not categorically assigned as an emigrant or not an emigrant. Rather, a *probability* that they emigrated is calculated for each individual.

[4] For more details about the approach, please read our paper that specifically discusses the methodology. Van Hook, J., Zhang, W., Bean, F. D. & Passel, J. S. (2006). Foreign-born emigration: A new approach and estimates based on Matched CPS Files. *Demography, 43,* 361-382 .

The basic approach for foreign-born population can be denoted in equation (1). The proportion of adults age 15+ in the CPS not followed up (u) is the sum of the proportion who died in the United States (d), the proportion who emigrated (e), and the proportion who were not followed up for other reasons (r).

$$u^f = m^f + d^f + e^f + r^f \quad (1)$$

Most of these terms can be estimated from existing data. The non-follow-up probability ($u^f$) may be estimated as the number of persons followed up in the March CPS in year t+1 divided by the number eligible to be matched in the March CPS in year t. The proportion of internal migrants ($m^f$) may be estimated, with certain adjustments, from the place-of-residence-one-year-ago question in the CPS. The probability of death ($d^f$), a small component except in the older ages, in this analysis, is estimated for the foreign-born using the matched NHIS-NDI files. Finally, there is the proportion of emigrants ($e^f$) and the probability of non-follow-up for other reasons ($r^f$) for the foreign-born left unsolved.

To estimate $r^f$, we make two assumptions in our methodology paper. The first is that foreign-born and second generation adults (s) have the same non-follow-up probabilities after adjusting for compositional differences in demographic characteristics. Thus:

$$\begin{aligned} r^f &= r^s \\ &= u^s - m^s - d^s - e^s. \end{aligned} \quad (2)$$

Substituting equation (2) into equation (1) and solving for $e^f$ yields:

$$e^f = u^f - m^f - d^f - (u^s - m^s - d^s - e^s). \quad (3)$$

To solve $e^s$, the second assumption states that the emigration probability of second-generation adults is negligible or essentially zero[5], and equation (3) reduces to an expression that can be calculated with existing data:

[5] In the methodology paper, the validity of the second assumption is addressed.

$$e^f = u^f - m^f - d^f - (u^s - m^s - d^s). \quad (4)$$

*The Second Generation*

The selection of a native-born comparison group is an important issue. The underlying assumptions of the matching method are that: (1) the native comparison group has very low rates of emigration; and (2) behaves similarly to the foreign-born with respect to the factors affecting the probabilities of non-follow-up of other reasons. Satisfying both assumptions simultaneously may be difficult. On the one hand, the third-or-higher generation (i.e., U.S.-born children of U.S.-born parents) may serve as a good comparison group because they may be less likely to emigrate than the second-generation as they tend to have fewer family connections overseas. On the other hand, the second generation may serve as a good comparison group because they may behave more similarly to the foreign-born vis-à-vis non-response than the third-or-higher generation (based on standard ideas about assimilation). If up-to-date estimates of emigration among the second generation could be obtained and factored into the final estimates, the first assumption could be relaxed. It would be more difficult, however, to relax the second assumption due to the difficulty in directly measuring generational differences in modeling non-follow-up for other reasons in the CPS. Therefore, to increase the likelihood that the second assumption about non-follow-up holds, the second generation rather than all natives or the third-or-higher generation is selected as the native comparison group.

*Internal Migration*

The estimates of internal migration are estimated on the question in the CPS that asks where the respondent lived one year before. CPS respondents in year t+1 who lived abroad a

year before (some of whom are "return immigrants" who emigrated but then returned to the U.S.) are excluded from the analytical sample since this group was not at risk of moving internally in year t. However, because the internal migration question in the CPS is retrospective, the population at risk—as it is measured in the CPS in year t+1—excludes some who were actually at risk of moving internally in year t such as those who died in the U.S. or emigrated in the previous year and are therefore no longer in the CPS universe. The "true" population at risk of moving internally between t and t+1 ($P_t^*$) is therefore equal to:

$$P_t^* = P_{t+1} / (1 - e - d),$$

where $P_{t+1}$ is the population at risk as it is measured in the CPS, $e$ is the percent emigrating, and $d$ is the percent dying in the U.S. between $t$ and $t+1$. Because $P_{t+1}$ is less than $P_t^*$, the unadjusted CPS-based estimates of internal migration, which use $P_{t+1}$ as a base, are too high. Therefore, the adjusted internal migration probability $m^*$ is calculated as $m^* = m\,(1 - e - d)$. For second generation adults, among whom e is assumed to be zero, the adjusted internal migration probability is $m^* = m\,(1 - d)$. This means that equation 4 expands to:

$$e^f = u^f - m^f(1 - e^f - d^f) - d^f - \left[u^s - m^s(1 - d^s) - d^s\right],$$

and rearranging terms:

$$e^f = \left[\, u^f - m^f + m^f d^f - d^f - u^s + m^s - m^s d^s + d^s \,\right] / (1 - m^f). \qquad (5)$$

*Percentages of Unhealthy Mexican Immigrants*

To obtain the percentages of people in poor/fair health, I adopt the general health question included in the CPS March supplements. The question originally is in the 5-point scale (1 = excellent; 2 = very good; 3 = good; 4 = fair; 5 = poor). In my analyses, the categories 1, 2, 3 are grouped into one category, denoting good health status and the categories 4 and 5 together

denoting poor/fair health status. Percentages of poor/fair health for Native whites and Mexican migrants who remained in the United States are directly derived from the data. Percentages of Mexican emigrants in poor/fair health are calculated taking into account estimates of emigration rates.

The procedures are:

(1) $N$ is the total number of Mexican migrants. $e$ is the overall Mexican emigration rate. Assuming the annualized emigration rate $e$ is constant across the time, I obtain the adjusted number of Mexican immigrants $N \times e^e$, adding back annual emigrants.

(2) $N_e$ is the number of Mexican emigrants from the United States.

$$N_e = N \times e^e - N \tag{6}$$

Equation (6) generates the number of Mexican emigrants by subtracting the adjusted total number of Mexican migrants (including emigrants) and the observed number of Mexican migrants, which is actually the number of Mexican migrants who remained in the United States.

(3) $N^u$ is the number of Mexican migrants, self-reported in poor/fair health. $e^u$ is the emigration rate of Mexican emigrants in poor/fair health. Assuming the annualized emigration rates for Mexican immigrants in poor/fair health is constant over the time, we have

$$N_e^u = N^u \times e^{e^u} - N^u \tag{7}$$

Equation (7) generates the number of Mexican emigrant in poor/fair health $N_e^u$ by subtracting the adjusted number of Mexican migrants in poor/fair health and the observed number of unhealthy Mexican migrants, which is actually the number of unhealthy Mexican migrants who remained in the United States.

(4) $\pi_e^u$ is the percent of Mexican emigrants who self-reported in poor/fair health.

$$\pi_e^u = \frac{N_e^u}{N_e} \tag{8}$$

Equation (7) generates the percent of Mexican emigrants in poor/fair health, which is used to compare with the observed $\pi^u$, the observed percentage of remaining Mexican immigrants in poor/fair health.

# RESULTS AND DISCUSSIONS

## Major Findings and Discussions

**Hypothesis 1 ─ The overall percentage of Mexican immigrants in poor/fair health are lower than that of Mexican Americans and Native whites, which indicates that Mexican immigrants do experience health advantage.**

In general, Mexican immigrants are lower in self-reported poor/fair health than Mexican Americans and Native whites (10.2, 11.3, and 15.8% respectively), reported in Table 1. The advantage stays at the same level for both gender, with a slightly difference for females between Mexican immigrants and Mexican Americans. However, the overall advantage of Mexican immigrants disappears for subgroups by ages. Such findings are consistent with the series of percentages in fair/poor health of Mexican immigrants and Native whites is similar to the figures of overall foreign-born and native-born populations reported by a recent study of Jasso and colleagues (see Table 7.1 in Jasso, Massey, Rosenzweig, & Smith, 2004). Notably, Mexican immigrants aged 25 to 54 exhibited lower percent of poor/fair health compared with Mexican Americans. The weight of this group in the total Mexican immigrant population is about 70% and pulls the overall health status toward the health status of this group. In addition, percentages in poor/fair health among poor Mexican immigrants, Mexican Americans, and native whites are also included in Table 1. Compared to the figures shown in the columns without controlling for poverty status, the disparities for the overall percentages in poor/fair health and percentages by gender are larger after controlling for poverty status. For the subgroups by age intervals, Mexican immigrants show relatively low percentages in poor/fair health; however, for people

aged 55+, Mexican immigrants still present relatively high percentages. Further studies with consideration of education levels may yield different results.

**Table 1 Percent of People in Poor/Fair Health Status, among Foreign-Born Mexican Immigrants, Mexican Americans, and Native Whites**

| | *Percent of People in Poor/Fair Health (%)* | | | *Percent in Poor/Fair Health among Poor People (%)* | | | *Number of People (N)* | | |
|---|---|---|---|---|---|---|---|---|---|
| Group or Characteristics | Mexican Immigrants | Mexican Americans | Native Whites | Mexican Immigrants | Mexican Americans | Native Whites | Mexican Immigrants | Mexican Americans | Native Whites |
| ***All*** | 10.2 | 11.3 | 15.8 | 12.3 | 15.1 | 23.5 | 15,708 | 6,756 | 22,613 |
| Male | 8.5 | 10.0 | 14.7 | 11.6 | 14.9 | 20.0 | 8,365 | 3,241 | 10,627 |
| Female | 12.4 | 12.6 | 16.8 | 13.0 | 15.2 | 25.9 | 7,343 | 3,515 | 11,986 |
| ***Age*** | | | | | | | | | |
| 15-24 | 3.9 | 3.8 | 3.1 | 4.8 | 6.5 | 5.0 | 3,167 | 2,669 | 2,257 |
| 25-34 | 5.4 | 5.7 | 3.5 | 7.7 | 11.4 | 6.8 | 5,170 | 1,429 | 2,304 |
| 35-44 | 8.5 | 9.5 | 4.7 | 10.6 | 16.1 | 10.8 | 3,723 | 891 | 2,768 |
| 45-54 | 16.6 | 16.7 | 8.6 | 20.1 | 28.7 | 21.3 | 1,955 | 635 | 2,786 |
| 55-64 | 27.6 | 26.9 | 13.5 | 38.8 | 36.2 | 28.0 | 972 | 469 | 2,827 |
| 65+ | 39.5 | 38.6 | 27.4 | 41.3 | 34.3 | 34.6 | 721 | 663 | 9,671 |
| ***Time in US*** | | | | | | | 15,708 | 6,756 | 22,613 |
| 0-5 | 6.1 | --- | --- | 6.7 | --- | --- | 2,958 | --- | --- |
| 5-10 | 6.1 | --- | --- | 8.7 | --- | --- | 3,121 | --- | --- |
| 10+ | 12.9 | --- | --- | 16.2 | --- | --- | 9,629 | --- | --- |

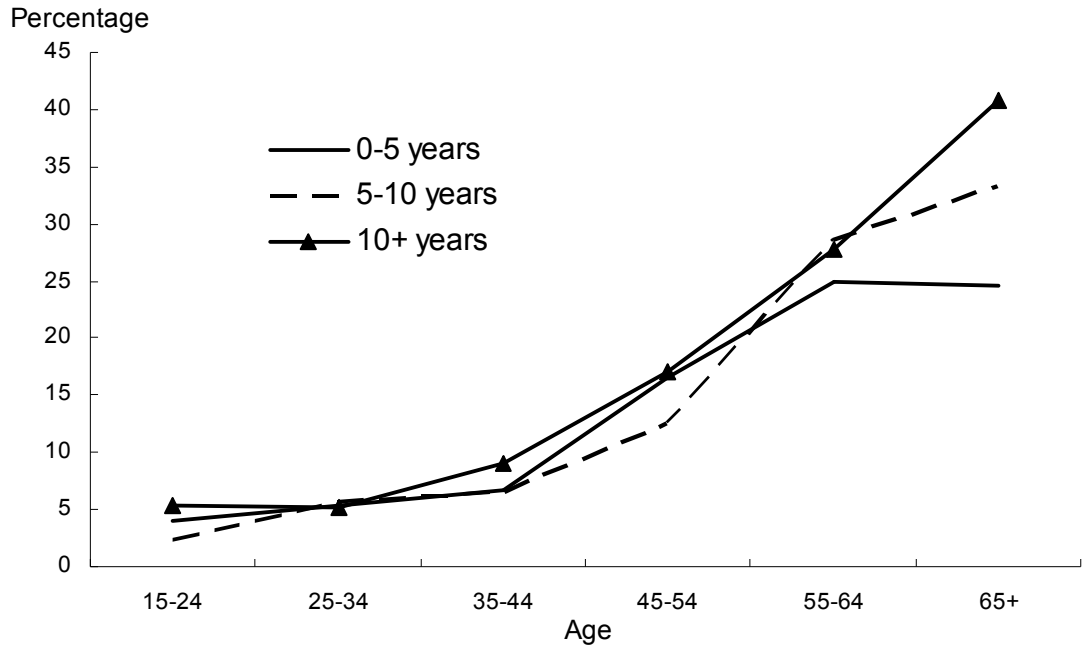
Table 1 also demonstrates that, Mexican immigrants with the longest time in the US report highest percent of poor/fair health compared with those who arrived recently (12.9% vs. 6.1%). With further data for subgroups by ages, Table 2 shows that the percent unhealthy among Mexican immigrants at different ages varies across different durations in the United States. Mexican immigrants at young ages, regardless time in the US, have similar unhealthy percentages. Old immigrants, especially those aged 65 and older, however, present a great increase in unhealthy percentages as period of residence increases. The pattern is well illustrated in Figure 1 that unhealthy percentages of elderly Mexican immigrants are positively related with the duration of residence. The effect of period of residence in the US on general self-reported

health status is thus inconsistent across age groups. This finding echoes the assimilation theory discussed earlier.

**Table 2 Percent of Mexican Immigrants in Poor/Fair Health Status by Age and Time in US (%)**

| | *Time in the U.S. (in years)* | | |
|---|---|---|---|
| **Age** | 0-4 | 5-9 | 10+ |
| 15-24 | 4.0 | 2.3 | 5.3 |
| 25-34 | 5.3 | 5.7 | 5.2 |
| 35-44 | 6.8 | 6.6 | 9.0 |
| 45-54 | 16.5 | 12.5 | 17.0 |
| 55-64 | 24.9 | 28.6 | 27.7 |
| 65+ | 24.5 | 33.3 | 40.9 |

**Figure 1. Percent of Mexican Immigrants in Poor/Fair Health by Time in US and Age**



**Hypothesis 2 ─ Emigration patterns among Mexican immigrants, with regard to gender, age, and time in the United States, are: (1) higher rates for male than for females; (2) higher rates for younger immigrants than for older immigrants; (3) rates decline as time in the United States increases.**

Table 3 displays the estimates of the various components of the emigration equation:

$$e = u - m - d - r$$

The results show that the overall annual emigration rates for Mexican immigrants are about 5.9%. The Mexican male emigration rate is about 4 times as the female emigrations rate, which agrees more with Ahmed and Robinson's estimates rather than Warren and Peck's. The situation may be due to frequent circular migration flows among male Mexicans. With regard to age, the emigration estimates generally decline with increasing age, despite the fluctuations associated with life cycles. The estimate for Mexican immigrants aged 55 and older is low as 0.3%, substantially decreasing the sample size for statistics on older emigrants. The results also reveal a pattern of decreasing emigration with increasing years in the US that is consistent with prior research (Ahmed & Robinson, 1994; Warren & Peck, 1980).

**Table 3 Estimated Components of Non-Follow-Up, Expressed in Percents (%)**

| Group or Characteristic | Emigration *e* | Non-Follow-Up *u* | Internal Migration *m* | Death *d* | Of Other Reasons *r* |
|---|---|---|---|---|---|
| ***All*** | 5.9 | 37.6 | 19.2 | 0.5 | 13.7 |
| Male | 9.0 | 41.1 | 20.2 | 0.6 | 13.7 |
| Female | 2.1 | 33.3 | 17.9 | 0.5 | 13.7 |
| ***Age*** | | | | | |
| 15-34 | 6.4 | 46.5 | 24.9 | 0.2 | 17.1 |
| 35-54 | 6.9 | 28.6 | 13.8 | 0.3 | 9.1 |
| 55+ | 0.3 | 23.2 | 8.4 | 2.8 | 11.9 |
| ***Time in US*** | | | | | |
| 0-4 | 10.0 | 48.8 | 26.7 | 0.3 | 15.1 |
| 5-9 | 7.2 | 43.7 | 23.0 | 0.3 | 15.3 |
| 10+ | 4.1 | 31.9 | 15.4 | 0.7 | 12.7 |

**Hypothesis 3 ─ The estimated emigration rates for Mexican immigrants in poor/fair health are higher than those of overall Mexican immigrants, thus indicating unhealthy selection in the process of emigration.**

***Hypothesis 3A ─The unhealthy out-migration selection effect is stronger among females than male immigrants.***

In Table 4, the overall emigration rate for less healthy Mexican immigrants is slightly higher than the emigration rates for their healthy (with 6.0 compared to 5.9). However, a difference emerges when the sample is broken down by gender. Male and female Mexican immigrants show opposite patterns, in that unhealthy women are more likely to emigrant while unhealthy men are actually a bit less likely to emigrate. It appears that although the emigration rate of unhealthy male Mexican immigrants is still much higher than that of unhealthy female Mexican immigrants, the gap between male and female decreases among Mexican immigrants with self-reported poor/fair health. For female out-migration, the unhealthy out-migration selection exists and the out-migration flows bring away people in poor/fair health. An extra finding is that although the out-migration selection exists in male Mexican immigrants as well, but the effect is in an opposite direction. Healthy male Mexicans are more like to be involved in out-migration than unhealthy males. Table 5 comparing the unhealthy percents among those who emigrate and those who stayed also confirms such gender differences.

**Table 4 Estimated Mexican Emigration Rates by Self-Reported Health Status, Sex, Age, and Time in US**

| Group or Characteristics | *Anuual Emigration Rates (expressed as percents)* | | |
|---|---|---|---|
| | For Total Population ($e$) | For Unhealthy People ($e^u$) | For Healthy People ($e^h$) |
| ***All*** | 5.9 | 6.0 | 5.9 |
| Male | 9.0 | 8.5 | 9.0 |
| Female | 2.1 | 2.6 | 2.0 |
| ***Age*** | | | |
| 15-34 | 6.4 | 8.9 | 6.32 |
| 35-54 | 6.9 | 5.6 | 7.02 |
| 55+ | 0.3 | 2.5 | --- |
| ***Time in US*** | | | |
| 0-4 | 10.0 | 11.1 | 9.94 |
| 5-9 | 7.2 | 7.2 | 7.22 |
| 10+ | 4.1 | 4.1 | 4.09 |

Note: "---" indicates that the estimates are very close to but less than zero.

**Table 5 Percent of People in Poor/Fair Health Status by Emigration Status, Sex, Age, and Time in the US**

| Group or Characteristics | *Percent of People in Poor/Fair Health (%)* | | *Number of People (N)* | | |
|---|---|---|---|---|---|
| | Stay $\pi^u$ | Emigrate $\pi_e{}^u$ | Total $N$ | Emigrant $N_e$ | Unhealth Emigrant $N_e{}^u$ |
| ***All*** | 10.1 | 10.2 | 15,708 | 953 | 98 |
| Male | 8.5 | 8.0 | 8,365 | 787 | 63 |
| Female | 12.4 | 15.5 | 7,343 | 155 | 24 |
| ***Age*** | | | | | |
| 15-34 | 4.8 | 6.7 | 8,337 | 555 | 37 |
| 35+ | 16.5 | 12.2 | 7,371 | 416 | 51 |
| ***Time in US*** | | | | | |
| 0-4 | 6.1 | 6.8 | 2,958 | 311 | 21 |
| 5-9 | 6.1 | 6.0 | 3,121 | 233 | 14 |
| 10+ | 12.9 | 12.9 | 9,629 | 402 | 52 |

***Hypothesis 3B —The unhealthy out-migration selection effect is stronger among younger and older ages compared to immigrants falling in middle age intervals.***

Table 4 clearly demonstrates that for young and old Mexican immigrants, those who reported poor/fair health status have higher emigration rates than those who remained in the US. For people aged 55+, the health selectivity in out-migration is so strong that the emigration rate among healthy immigrants is close to zero. In order to have enough cases to calculate unhealthy percentages among Mexican emigrants, people aged 35 and older are grouped together, which generates a lower unhealthy percentage for Mexican emigrants compared to those who stayed in the United States (Table 5).

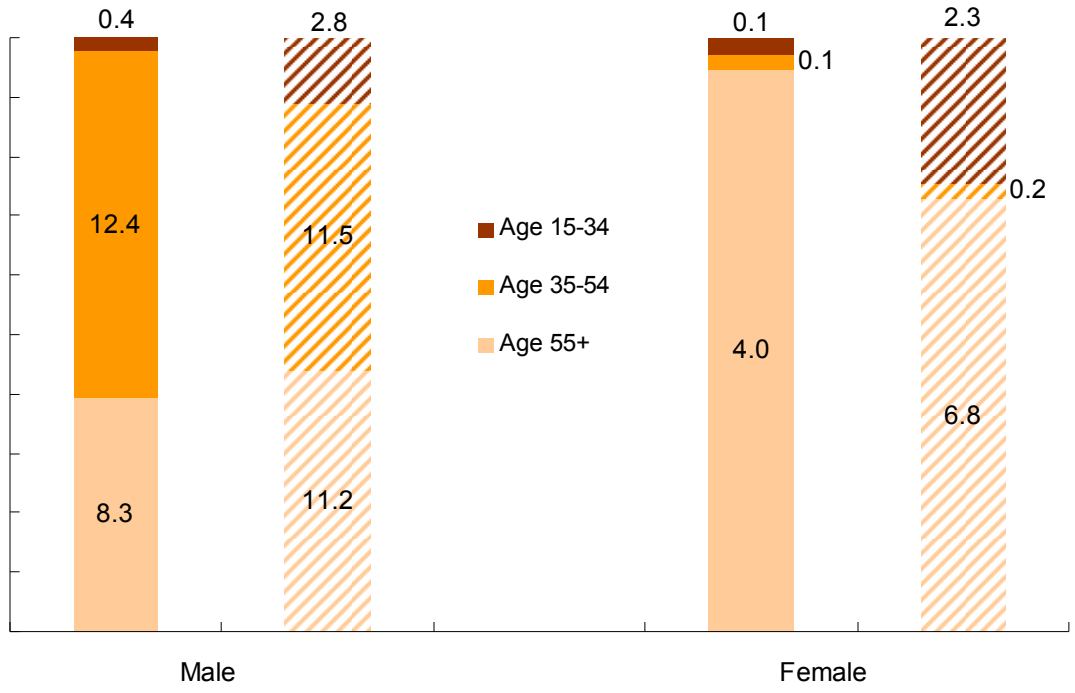
Note that we have different pattern in the health-emigration relationship for different gender. For male out-migration, healthy immigrants are more likely to emigrate than unhealthy immigrants. However, the evidence in Table 6 and Figure 2 shows that for younger and older Mexican immigrants, the unhealthy selectivity occurs in male out-migration as well. Male immigrants age 15-34 who were in poor/fair health report higher emigration rates compared to those in a healthy status (11.2 vs. 8.2). For older immigrants aged 55+, the gap becomes even larger: unhealthy people, on average, generate a 2.8 high emigration rate; while for healthy people, the emigration rate is close to zero. The same pattern emerges in female immigrants. Figure 2, in addition, shows a large increase in emigration rates among unhealthy younger and older people (bars with a twill pattern) compared to the average rates. The effect of the unhealthy selectivity in out-migration is particularly strong for elderly Mexican immigrants. The unhealthy selectivity operating in the process of out-migration may result in a relative small number of deaths at old ages.

**Table 6 Estimated Emigration Rates by Health Status, Age, and Time in the U.S., among Mexican Males and Females**

| Group or Characteristics | *Anuual Emigration Rates by Gender (expressed as percents)* | | | | | |
|---|---|---|---|---|---|---|
| | Male | | | Female | | |
| | $e$ | $e^u$ | $e^h$ | $e$ | $e^u$ | $e^h$ |
| ***Age*** | | | | | | |
| 15-34 | 8.3 | 11.2 | 8.2 | 4.0 | 6.8 | 3.8 |
| 35-54 | 12.4 | 11.5 | 12.5 | 0.1 | 0.2 | 0.1 |
| 55+ | 0.4 | 2.8 | --- | 0.1 | 2.3 | --- |
| ***Time in US*** | | | | | | |
| 0-4 | 13.6 | 16.8 | 13.4 | 4.9 | 5.8 | 4.8 |
| 5-9 | 10.6 | 10.5 | 10.6 | 3.4 | 4.8 | 3.3 |
| 10+ | 6.8 | 6.8 | 6.8 | 0.8 | 1.8 | 0.6 |

Note: "---" indicates that the estimates are very close to but less than zero.

**Figure 2. Estimated Emigration Rates for Mexican Immigrants by Gender, Age, and Health Status**



***Hypothesis 3C — The pattern of out-migration selection effect observed for different ages and gender does not vary with the duration of residence.***

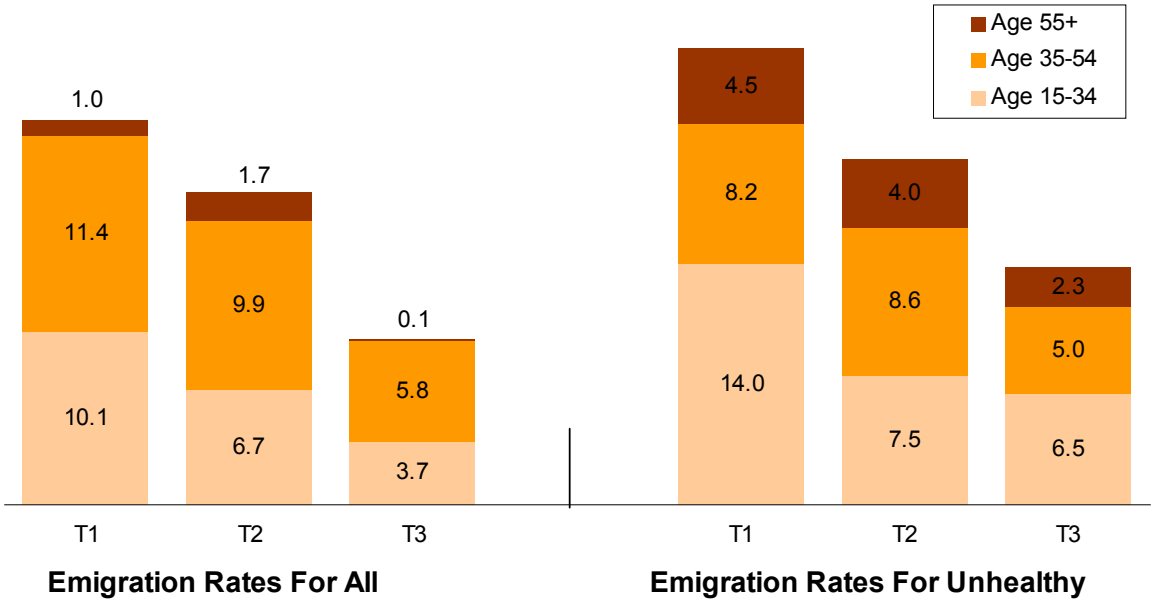
The emigration rates by duration in the U.S. for unhealthy immigrants are nearly identical to the pattern and levels for all immigrants, in which Hypothesis 3C is supported. Rather than variations by time in the U.S., the most interesting findings are revealed when the analysis is constructed for different age intervals. Table 7 and Figure 3 show that Mexican immigrants with poor/fair health aged 15-35 and 55+ are more likely to emigrate compared to average estimates of each age interval respectively. This finding is consistent with the previous evidence for Hypothesis 3B of the age factor. Mexican immigrants aged 35-54 in poor/fair health are less likely to emigrate relative to the average. This group of people may have obtained permanent and satisfactory employment in the United States, which reduces the likelihood of returning home. It is also possible that middle-aged immigrants may choose to stay in the United States when they experience health problems, because of advance Medicare.

**Table 7 Estimated Emigration Rates among Mexican Immigrants by Health Status, Age, and Time in the US (as percents)**

| | ***Time in the U.S.*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0-4 Years | | | 5-9 Years | | | 10+ Years | | |
| ***Age*** | $e$ | $e^u$ | $e^h$ | $e$ | $e^u$ | $e^h$ | $e$ | $e^u$ | $e^h$ |
| 15-34 | 10.1 | 14.0 | 9.9 | 6.7 | 7.5 | 6.7 | 3.7 | 6.5 | 3.6 |
| 35-54 | 11.4 | 8.2 | 11.7 | 9.9 | 8.6 | 10.0 | 5.8 | 5.0 | 5.9 |
| 55+ | 1.0 | 4.5 | --- | 1.7 | 4.0 | 0.7 | 0.1 | 2.3 | --- |

Note: "---" indicates that the estimates are very close to but less than zero.

**Figure 3 Estimated Emigration Rates for Mexican Immigrants by Age, Time in the U.S., and Health Status**




In Figure 3, the major disparities in estimated emigration rates are observed among different age intervals, and such differences remain at a similar level regardless of time in the United States. It is clear that emigration rates for unhealthy Mexican immigrants at young and old ages are much higher than the overall rates of the corresponding age groups. The factor of duration of residence does not appear to show significant impact on the age pattern.

In sum, selective out-migration exists in the process of emigration among Mexican immigrants. Such selections are obviously negative for younger and older age groups, resulting in relative high emigration rates among unhealthy people falling into these two age intervals. For Mexican immigrants at working ages, the selection appears to be positive, which indicates that emigration is more likely among healthy Mexican immigrants. This may occur because the sample includes a large number of annual circular migrations, which are most likely to be observed among Mexican immigrants. Compared to estimates produced using the residual

method for a 10-year period, emigration rates calculated in this article include temporary out-migrations, which may be greatly different from permanent out-migrations vis-à-vis health status. Although the two sets of comparisons demonstrate the out-migration selection effect on the assessment of general health status of remaining Mexican immigrants, minor differences shown in the percentages suggests the small magnitude of the effect.

## Cumulated Out-Migration Effects

The emigrant population represents a small population relative to the U.S. resident foreign-born population. However, if such small differences remain at a similar level for decades, the cumulative effect may still cause significant changes to the composition of foreign-born populations that remain in the U.S. In order to demonstrate this, I construct a set of life tables for different cohorts, using observed unhealthy percentages and estimated emigration rates for unhealthy people. Based on earlier results, I choose cohorts aged 15 and 55, which experience negative selection in the process of emigration. Take the cohort aged 55 who has been in the United States for more than 10 years (see Appendix Table 1 for life table calculations). The initial average unhealthy percent is .335, the overall emigration rate is .001, and the average emigration rate for unhealthy people is .023. The healthy percent is about .67 and increases to .73 after a decade due to there being relatively more unhealthy decrements than overall decrements. Table 10 shows that cohorts with different levels of initial unhealthy percentages and negative out-migration selections produce different amount of changes in percentages of healthy people who remained in the United States. For a cohort with a high initial unhealthy percent and a high emigration rate for unhealthy people relative to the overall estimate, the percent change in percentages of healthy people who remained in the United States may

reach as high as 10% over a ten-year period.

**Table 8 Out-Migration Effect, Cumulated after a Decade, on Health Status of Mexican Population in the U.S., for Cohorts with Different Demographic Characteristics**

| | Cohort Aged 15 | | | | Cohort Aged 55 | | | |
|---|---|---|---|---|---|---|---|---|
| **Time in the U.S.** | Emigration Rate For Total $e$ | Emigration Rate for Unhealth People $e^u$ | Proportion of Unhealth People $\pi^u$ | % Change in Proportions of People in Good Health | Emigration Rate For Total $e$ | Emigration Rate for Unhealth People $e^u$ | Proportion of Unhealth People $\pi^u$ | % Change in Proportions of People in Good Health |
| 0-4 | 10.1 | 14.0 | 4.5 | 1.4 | 1.0 | 4.5 | 24.8 | 8.9 |
| 5-9 | 6.7 | 7.5 | 4.3 | 0.3 | 1.7 | 4.0 | 30.8 | 8.3 |
| 10+ | 3.7 | 6.5 | 5.2 | 1.2 | 0.1 | 2.3 | 33.5 | 9.0 |

## Limitations

We have examined the effect of out-migration on the percentage in fair/poor health among Mexican immigrants who remained in the United States. The results reveal emigration selectivity by health status among Mexican immigrants. The pattern of selectivity varies by age and gender. For Mexican emigrants at the beginning and end of life cycles, people in self-reported poor/fair health are more likely to emigrate. The out-migration hypothesis proposed for explaining Hispanic Paradox is supported for these two groups. For male Mexican immigrants and people aged 35-54, however, the health selectivity runs in the opposite direction. It is possible that emigration among middle-aged male Mexican immigrants is largely of temporary flows.

Emigrants comprise a small proportion of the immigrant population in any given year. Estimates of unhealthy out-migration effects are small over the course of a single year. However, even small differences may lead to substantial bias to the health assessment of remaining foreign-born population over longer time periods such as a decade, as shown in the final section of the results. The magnitude of the effect depends on the initial unhealthy percentages and the

ratio of unhealthy decrements to healthy decrements of a foreign-born population.

These findings are suggestive but not complete, because of the confounding effect of temporary out-flows, which may lead to the results observed for specific groups among Mexican immigrants. It would be useful to also analyze health selectivity of return immigration among those who recently emigrated from the United States. There are other limitations of this study. It is mentioned earlier that the emigrant population comprises such a small fraction of the total foreign-born population residing in the United States that the emigration estimates are very sensitive to standard errors. It is therefore important to be cautious when interpreting the results. In terms of the self-reported health measurement, the possible bias within the Mexican immigrant population is not taken care of. For example, reporting variations in self-reported health across different residing states, and/or at different levels of acculturation may exist (Palloni et al., 2004).

The study of out-migration effects on immigrant health has potentials and presents challenges. Palloni et al. (2004) claimed that ideal data for the evaluation of Salmon Bias may be a direct comparison between those who stayed and those who left within an immigrant population. This would require follow-up mortality information of emigrants, which is not available at this time. This study demonstrates a quasi method, which enables the direct comparison in health situation between emigrants and those who remained in the United States. Future work needs an incorporation of an objective measure of health, which may be a more powerful and predictive for subsequent mortality experience. Moreover, to disentangle the effect of temporary and permanent emigrations on the health assessment of remaining immigrant populations is one of the future goals.

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# APPENDIX

## Appendix Table 1

**Calculations of Cumulative Out-Migration Effect, Using Emigration Estimates and Observed Proportions of Mexicans in Poor/Fair Health**

| | *Cohort Aged 55, 10+ Years in US* | | | | |
|---|---|---|---|---|---|
| ***Age x*** | *Total (e)* $q_x$ | *Total ($\pi_x$)* $l_x$ | *Unhealthy ($e^u$)* $q_x^u$ | *Unhealthy ($\pi_x{}^u$)* $l_x^u$ | *Proportion of People in Good Health ($\pi_x{}^h$)* |
| 55 | 0.0010 | 1.0000 | 0.0230 | 0.3350 | 0.67 |
| 56 | 0.0010 | 0.9990 | 0.0230 | 0.3274 | 0.67 |
| 57 | 0.0010 | 0.9980 | 0.0230 | 0.3199 | 0.68 |
| 58 | 0.0010 | 0.9970 | 0.0230 | 0.3127 | 0.69 |
| 59 | 0.0010 | 0.9960 | 0.0230 | 0.3056 | 0.69 |
| 60 | 0.0010 | 0.9950 | 0.0230 | 0.2986 | 0.70 |
| 61 | 0.0010 | 0.9940 | 0.0230 | 0.2918 | 0.71 |
| 62 | 0.0010 | 0.9930 | 0.0230 | 0.2852 | 0.71 |
| 63 | 0.0010 | 0.9920 | 0.0230 | 0.2787 | 0.72 |
| 64 | 0.0010 | 0.9910 | 0.0230 | 0.2724 | 0.73 |
| **% Change in the Proportion of People in Good Health** | | | | | **9.05** |

Assumptions:

1) the estimated total emigration rate for the cohort is 0.1;

2) the estimated emigration rate for the corhot in poor/fair health is 2.3;

3) the observed percent of the cohort in poor/fair health is 33.5%;

4) $\pi_x^h = 1 - (\pi_x^u / \pi_x)$

## Appendix Table 2

### Logistic Regression Models of Internal Migration and Non-Follow-Up Among First and Second Generation Mexican Origin People

| | Internal Migration | | Non-Follow-Up | |
|---|---|---|---|---|
| | 1st Generation | 2nd Generation | 1st Generation | 2nd Generation |
| CPS Oversample | -0.922 *** | -0.997 *** | -0.024 | 0.094 |
| Homeowner | -0.845 *** | -1.434 *** | 1.089 *** | 1.088 *** |
| Male | 0.065 | 0.025 | -0.278 *** | -0.029 |
| Age | | | | |
| 15-24 | 1.493 *** | 1.101 *** | -1.074 *** | -0.635 *** |
| 25-34 | 0.973 *** | 0.910 *** | -0.409 ** | -0.429 ** |
| 35-44 | 0.707 ** | 1.027 *** | -0.066 | -0.067 |
| 45-64 | 0.322 | -0.018 | 0.101 | 0.006 |
| School Enrollment | | | | |
| High School | -0.453 ** | -0.807 *** | 0.727 *** | 0.259 * |
| College | -0.998 *** | -0.273 | 0.660 ** | 0.023 |
| Good Health | 0.054 | -0.244 | -0.068 | -0.114 |
| Intercept | -2.122 *** | -1.238 *** | 0.582 ** | 0.527 * |
| N | 13,462 | 5,882 | 13,197 | 5,857 |
| -2LL Chi-Square | 779 | 406 | 1118 | 380 |
| Pseudo R-square | 0.096 | 0.142 | 0.090 | 0.068 |

Source: 1996-2004 March Current Population Survey (see text for description of sample)
*** p<.001 ** p<.01 *p<.05