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# English fluency of the US immigrants: Assimilation effects, cohort variations, and periodical changes

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ABSTRACT

Using 1% Public-Use Microdata Samples (PUMSs) of the 1980, 1990, and 2000 census and the 2010 American Community Survey (ACS), this study evaluates three simultaneous longitudinal trends in immigrants' English fluency: the assimilation process, variations across arrival cohorts, and periodical changes. The key findings include that the declining initial English fluency among new immigrants reported in a previous study based on 1980 and 1990 data (Carliner, 2000) was reversed in the 1990s and 2000s. Immigrants who arrived during the 2000s have the highest level of English fluency at the year of entry among all cohorts. Immigrants are assimilating. However, changes in social and linguistic environment in the US during the past two decades have suppressed the advancement of immigrants. The decline in the average English attainment from the 1980s to the 1990s reported in a previous study (Pitkin and Myers, 2011) was found to extend to the 2000s. Using new census data, this study updated the current knowledge on immigrants' English fluency by revealing a never documented upward trend among recent immigrants and suppressive period effects from 1990 to 2010.

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## 1. Introduction

The massive influx of immigrants to the United States during the past few decades has brought with it a noticeable increase in the size of its non-English speakers. In 2000, data from the U.S. Census Bureau indicate that 18% of the total population aged 5 and above (47 million) spoke a language other than English at home. The comparable figures were 14% (31.8 million) in 1990 and 11% (23.1 million) in 1980 (U.S. Census Bureau, 2003). Although most of these immigrants speak English very well, it has been observed also that the proportion of immigrants who do not speak English well is on the rise (U.S. Census Bureau, 2003). Indeed the U.S. Census Bureau pointed out that the percentage of the total US population aged 5 and over who were non-proficient in English grew from 4.8% in 1980, to 6.1% in 1990, and 8.1% by 2000 (U.S. Census Bureau, 2003).

The rapid increase of America's foreign born population who do not speak English well has fueled nation-wide anti-immigrant sentiment in the US. One popular explanation as to why these immigrants do not speak English well points to their lack of assimilation. It is therefore not surprising that the English-only movement, resurrected since the 1980s, has pushed the issue of English skills to the frontline of public discussion on immigration. This debate has in turn triggered extensive research interests in immigrants and their English skills.

Researchers point out that the observed trend in immigrants' English fluency is a product of different sources of changes (Myers and Pitkin, 2010). At the individual level, it has been suggested that immigrants learn English as their length of residence in the US increase. Previous studies have documented a robust assimilation effect (e.g., Chiswick and Miller,

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1995, 2002; Stevens, 1994). Although many new immigrants do not speak English very well on their arrival, they pick up English as they stay in the US longer.

At the aggregate level, cohorts of immigrants who arrived at different historical times might differ in their English skills on their arrival. They might also differ in their linguistic assimilation rates. If early cohorts speak better English at their arrival and/or attain English at higher rates than recent cohorts, a temporal decline would be observed. In other words, the changing cohort composition over time would contribute to temporal changes in average fluency. Indeed literature has documented significant variation across immigration cohorts due to historical changes in immigration streams and admitting criteria. Using the 1980 and 1990 censuses, Carliner (2000), for example, reported a linear and declining trend in English fluency among new immigrants since the 1950s. However, little is known as to whether or not this trend holds true for new immigrants who arrived after 1990. By analyzing data on recent immigrants, one of the goals of this study is to test Carliner's (2000) observation.

In addition to assimilation and cohort variations, the average level of English fluency among immigrants can be affected by temporal changes in macro social and linguistic environment. For example, some argued that the increased scale of ethnic enclaves and rapid growth of ethnic group size in recent decades has increased the opportunity of using mother tongues and suppress the acquisition of English (Stevens, 1992; Hwang and Xi, 2008). A recent study has also demonstrated the existence of periodical fluctuation in English fluency that is above and beyond assimilation and cohort effects (Pitkin and Myers, 2011). Indeed the study documented a decline in average English attainment from the 1980s to the 1990s among Mexican and Asian immigrants after controlling for assimilation and cohort effects. Because the decline in English fluency goes against the accelerating advancement in other aspect of integration (Pitkin and Myers, 2011), new research is needed to test the findings and to evaluate if the trend continues after 2000, something we attempt to do here in this study.

Despite the fact that assimilation, cohort differences, and periodical fluctuation together create the observed trend in English fluency among immigrants, previous studies have not estimated the three simultaneously. The current study attempts to fill the gaps. In this study, we define assimilation effect as changes in English fluency associated with the increasing duration or length of residence in the US. Cohort effect is defined as differences across arrival cohorts due to their unique composition of country of origin and historical changes in criteria for admission. Period effect is defined as contextual effects that are unique to a given time period above and beyond assimilation and cohort variations. This study asks the following questions: (1) What are the assimilation, cohort, and period effects on immigrants' English fluency that are net of each other? (2) Does the linear decline in English fluency of new entrants documented in the literature hold true for immigrants that arrived after 1990? (3) Are there any cohort differences with respect to the linguistic assimilation trajectories? (4) Does the periodical decline reported in the literature continue in the 2000s? In answering these questions, we use four waves of repeated cross-sectional data collected by the U.S. Census Bureau in 1980, 1990, 2000, and 2010. This study would extend the current knowledge on immigrants' English fluency through disentangling the effects of three simultaneous changes on English fluency, and through including new census data to reveal trends that have not been reported in previous studies.

### *1.1. Duration of residence: assimilation effect*

Although different studies on immigrants' English skills focus on a different set of language determinants, assimilation effects, which usually is measured by the duration in the host society, is indispensable in building a language model. The majority of empirical studies have concluded that a longer duration in the host society is associated with greater proficiency in the host society's dominant language (Chiswick and Miller, 2002; Jasso and Rosenzweig, 1990). The positive effects of length of residence were confirmed among immigrants in the US, the UK, Australia, Canada, and Germany (Dustmann, 1994; Dustmann and Fabbri, 2003; Espenshade and Fu, 1997).

Earlier studies of assimilation effects based on cross-sectional data have been criticized for "the cross-sectional cohort fallacy" (Pitkin and Myers, 2011, p. 263). Early cohorts who have stayed the longest in the US are mostly from European countries while the newer cohorts are mostly from Latin America and Asia. If, at the time of entry, earlier cohorts speak better English than the newer ones, the observed effect of duration in cross-sectional data would actually reflect both an assimilation effect and the initial cohort differences. Without taking cohort effects into consideration, one cannot make unbiased estimation on the assimilation effect.

Studies using longitudinal data to control for cohort effects have also confirmed the effects of assimilation. Focusing on one single cohort who arrived between 1985 and 1989, Myers and Pitkin (2010) found substantial improvement in English proficiency from 1990 to 2008 among immigrants in general, and Latino immigrants in particular. However, the restriction to a single cohort precludes the estimation of cohort variation which is also of great theoretical importance.

### *1.2. Time of arrival: cohort variation*

The changes in the flows of immigration during the past century suggest great cohort variations in the English skills of these immigrants at entry and the speed they pick up English after arrival. As highlighted by Borjas (1994), immigrants who arrived before 1965 were mostly from Canada and European countries. However, the immigration flows after 1965 have changed dramatically with most immigrants coming from Asian and Latin American countries. Immigration cohorts defined by the arrival time not only represent changes in immigration flows, but also reflect the changing admission criteria in the past century. For example, early immigration policies such as the Chinese Exclusion act in 1882 and the national-origins

quota system in early 1920s allocated visas based on race and country of origin. In 1965, the national-origins quota system was largely repealed and US immigration policy prioritized immigration by family ties instead of the skill sets an immigrant possessed. In the past few decades, the 1965 amendments have been modified at various times. Among the revisions, the Immigrant Act of 1990 has expanded the scale of skill-based immigration (Congressional Budget Office, 2006).

Although history shows that immigrants speaking different European languages during the massive immigration waves at the turn of the 20th century obtained English proficiency successfully, there is a concern that the success story of older cohorts might not be applicable to the newer ones. The major reason documented in the literature is the declining "quality" of recent immigrants, especially when it comes to their educational attainment (Borjas, 1994). The shifting of the mix of countries of origin and admission criteria has brought with it the decline in level of education (relative to natives) among immigrants (Borjas, 1994). Because higher education signals better cognitive skills and higher general capability, such a decline hinders their English skills, some have argued. Therefore, it is possible that newer cohorts not only have lower English skills at arrival, but also have attained English at a lower rate after arrival than the older ones. The linguistic distance is another obstacle for newer cohorts, as a lot of them are from Asia. Literature suggests that linguistic distances between mother tongues and host society's languages predict difficulties of acquisition of host society's languages (Hwang and Xi, 2008). Since English, in general, shares more common features with German than with Chinese or Korean, it would be more difficult for Asian immigrants to reach English fluency.

Although literature has documented important cohort differentiations in immigrant's economic assimilation process (Borjas, 1994), cohort differences were not a focus of the language assimilation literature. One important research that has strived to simultaneously estimate the assimilation and cohort effects on English fluency was conducted by Carliner (2000) using the 1980 and 1990 census data. In this study, Carliner (2000) found a linear decline in English fluency across cohorts. The cohort effect was fully accounted for by education and the country of origin, a finding that echoes Borjas' claim that the change of national origin mix in the immigration flow is responsible for the decline in the economic status of newer immigrant cohorts (Borjas, 1994). Although enlightening, his findings were based on the 1980 and 1990 data only. The linear and declining cohort pattern might not hold true for immigrants that came after 1990.

Using the 1990 and 2000 census data, a recent study has found an upturn in economic achievement and educational attainment for cohorts that arrived during the 1990s (Borjas and Friedberg, 2009). One stated reason for the upturn is the immigration policy changes in 1990 which expanded the scale of skill-based immigration. Given the relatively stable mix of country of origin since the 1980s (U.S. Census Bureau, 2010), combined with the increased average educational attainment among new comers during the 1990s, and the increased usage of English as a global language, it is possible that newer arrival cohorts that were not captured in old censuses are more fluent in English than their earlier counterparts. Taking advantage of the availability of new census data, we examine whether or not the trends detected in old census data hold for immigrants who arrived after 1990.

Focusing on overall cohort variation, Carliner (2000) did not compare cohort specific trajectories of English fluency attainment. Because the overall differences among cohorts with the same duration in the US are actually the sum of two components: fluency at arrival, and assimilation after arrival, it would be informative to compare cohorts with respect to their fluency levels at entry and after 10, 20, and 30 years in the US.

### *1.3. Survey year: period effects*

With only two waves of data, Carliner's (2000) study ignored any possible period effects. It is possible that periodical changes over time simply reflect unique cohort or duration composition at different time periods. If this is true, controlling for cohort and assimilation effects, there should be no period differences. However, a previous study has reported period differences that are net of cohort and assimilation effects (Pitkin and Myers, 2011). Specifically, the average advancement in English fluency for a typical immigrant was found to be greater in the 1980s than in the 1990s. This is true for Mexican immigrants and for immigrants from Asia as well.

Evidence shows that the linguistic environment in the US metropolitan areas is changing. At a specific time period, the unique linguistic environment can affect cohorts of immigrants in their English skills (Alba and Nee, 1997). The previous era of mass immigration, a period before 1930, was followed by a four-decade hiatus in the stream of mass immigration (Alba and Nee, 1997). As immigrants picked up English and assimilated into the host society they were not replaced by a continuing immigration stream. The second generations were native speakers of English. As a result, immigrants' mother tongue diminished in this unique linguistic environment and their English ability was reinforced (Alba and Nee, 1997). The linguistic environment has changed since 1965 as the magnitude of the immigration stream began to steadily increase. The number of non-English speakers has more than doubled from 1980 to 2000 (Alba and Nee, 1997).

A striking feature of recent immigration trends in the US is its ethnic concentration. While the top five states of immigrant destination received 54% of all immigrants arriving during 1901–1930, their share has risen to 78% during the period from 1971 to 1993 (Massey, 1995). Census 2000 indicates that among the 47 million people who spoke a language other than English at home in 2000, 28.1 million were Spanish speakers and they were more geographically concentrated than English speakers (U.S. Census Bureau, 2003). Indeed an analysis of 2000 census data showed that over 56% of foreign-born Cubans lived in Miami, Florida; California and Texas together accounted for over half of foreign-born Mexican immigrants; and more than 55% of immigrants from countries such as China and Iran settled in California and New York. Previous studies have repeatedly demonstrated that large ethnic group size and concentration facilitate the use of mother tongue and suppress

English acquisition (Chiswick and Miller, 1995, 2002; Hwang and Xi, 2008; Stevens, 1992). The prevailing trend of ethnic concentration creates a linguistic environment that would suppress both old and new cohorts in their use of English.

Although literature suggests that assimilation, cohort differences, and periodical changes are three simultaneous temporal sources of variations in immigrants' English fluency, so far, none of the previous studies that have looked at immigrants and English language skills has estimated assimilation, cohort, and period effects simultaneously or has examined cohort-specific English attainment trajectories. Little is known about linguistic assimilation for the post-1990 cohorts and periodical changes after 2000. The current study attempts to fill these gaps. Specifically, we attempt to test the following hypotheses: (1) there is an assimilation effect on immigrants' English fluency net of cohort variation and periodical changes; (2) immigrant cohorts differ in English fluency on arrival; (3) immigrant cohorts also differ in language assimilation rates; (4) net of cohort and assimilation effects, there is an effect associated with periodical social changes on immigrants' English fluency.

## 2. Data and methods

The data for this study were derived from Integrated Public Use Microdata Series (IPUMS-USA) (Ruggles et al., 2010) and contained 1% Public Use Microdata Samples (PUMSs) of the 1980, 1990, and 2000 census and the 2010 American Community Survey (ACS). The 2010 ACS sample derived from IPUMS contains 1% of the US population.[1] The inclusion of the 2010 ACS allows us to extend the study period to 30 years with four repeated cross-sections. Because of the lack of consistent measures of English fluency in earlier censuses, they were not included in the study. Also immigrants who arrived before 1950 were excluded in regression analysis because they were treated as one open ended category in the 1980 and 1990 census data. To facilitate comparisons with previous studies (e.g. Carliner, 2000), the sample was limited to working-aged (18–64) foreign-born and excluded immigrants from English speaking countries in the regression analysis.[2]

### 2.1. Measurement

The outcome variable, *English language fluency*, was measured consistently from the 1980 to 2000 census and in the 2010 ACS using five fluency categories (i.e., English only, very well, well, not well, and not at all). According to the Census Bureau, respondents who said they spoke only English or spoke English "very well" were considered to have no difficulty with English. Those who responded that they spoke English "well," "not well," or "not at all" were considered to have difficulties with English (U.S. Census Bureau, 2003). Because most studies in the past have recoded the ordinal variable into a dichotomy (e.g., Chiswick and Miller, 1995), to facilitate comparison, we followed this practice and coded the variable as "1" if the respondent spoke English only or very well, and "0" if otherwise.[3]

Three types of time-related information: *years since migration, year of entry*, and *survey year* were included in the study to delineate the unique effects of assimilation, cohort, and period. The number of years an immigrant has lived in the US, *years since migration* (*YSM*), was measured as (survey year – year of entry). This variable was not centered so that the intercept in the regression model represented English fluency at the year of entry. In the 1980 and 1990 census, year of entry was not coded as single years but ranges of years. Following Carliner (2000), we assigned the midpoint of each range as the value of the year of entry. Immigrants were grouped into *5-year immigration cohorts* according to their year of entry.

Another time related variable that was relevant for English fluency was *age at migration*. *Age at migration* was defined by (age – (survey year – year of entry)) or 0, whichever was bigger. It was grand mean-centered. Because the initial measure for *educational attainment* was categorical in census data, following Chiswick and Miller (1995), we reconstructed it by assigning the following values to the census categories: completed less than fifth grade (2.5 years); completed fifth through eighth grade (7 years); completed ninth grade (9 years); completed 10th grade (10 years); completed 11th grade (11 years); completed 12th grade or high school (12 years); attended or completed college (14 years); Bachelor's degree (16 years); Master's degree (17.5 years); Professional Degree (18 years); Doctorate (20 years). This variable was centered by its grand mean also. In addition, a dummy variable was used to indicate whether the respondent is a male.[4]

Most previous studies categorize immigrants by their place of origin into regions or continents (Chiswick and Miller, 1995; Carliner, 2000). Similarly, we grouped immigrants into 16 *place-of-origin* categories: Mexico, Cuba, other Central America, South America, China, Korea, other East Asia, Philippine, Vietnam, other Southeast Asia, India, other South Asia, Middle East, Africa, European countries, and other (including pacific islands and unspecified places of origin).

[1] A set of systematic evaluation of quality of the ACS conducted by the Census Bureau has indicated that the overall coverage rates and response rates are both higher in the ACS than in the census long form (U.S. Census Bureau, 2004). Comparing the 2000 CAS and the census long form, estimates were found to be quite similar. The Census Bureau has concluded that the ACS has a quality as high as the census long form (U.S. Census Bureau, 2004). In 2010, the ACS has replaced the census long form survey.

[2] Consistent with Carliner (2000), English speaking countries was defined as all countries from which at least half of the immigrants in the 1990 census reported speaking only English. It therefore includes Canada, Bermuda, Jamaica, Anguilla, Antigua, Aruba, Bahamas, Barbados, Cayman Islands, Grenada, Monsterrat, St. Barts, St. Kitts, St. Lucia, St. Vincent, Trinidad, Turks and Caicos, Belize, Guyana, United Kingdom, Ireland, Gibraltar, Liberia, Zimbabwe, South Africa, Australia, and New Zealand. We reran the analysis for the sample including all sources countries and there was no noticeable difference in results.

[3] In a sensitivity analysis, we have rerun the analysis treating the ordinal measure of English fluency as an interval level variable. There was no noticeable difference in results.

[4] In a sensitivity analysis, we have controlled for the presence of young kids at home but it has never been significant and thus was dropped from the final analysis.

**Table 1**
Percentage of working age immigrants who are fluent in English by cohorts and survey years.[a]

| Cohort | Year of survey | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1980 | | 1990 | | 2000 | | 2010 | |
| | % Fluent | *n* | % Fluent | *n* | % Fluent | *n* | % Fluent | *n* |
| Pre-1950 | 85.2 | 15,665 | 84.9 | 4655 | 89.4 | 1532 | 95.0 | 598 |
| 1950–1960 | 71.8 | 16,708 | 80.3 | 13,819 | 84.6 | 9942 | 93.8 | 6895 |
| 1961–1965 | 64.7 | 11,875 | 74.4 | 11,637 | 77.2 | 9054 | 87.4 | 5731 |
| 1966–1970 | 52.8 | 14,924 | 66.4 | 14,819 | 67.7 | 15,212 | 75.0 | 11,089 |
| 1971–1975 | 43.1 | 17,354 | 59.4 | 19,735 | 60.5 | 18,840 | 65.3 | 15,400 |
| **1976–1980** | **35.4** | 22,701 | **51.0** | 22,274 | **54.6** | 29,739 | 57.1 | 25,176 |
| 1981–1985 | | | 41.7 | 28,302 | 50.8 | 32,021 | 55.9 | 26,686 |
| **1986–1990** | | | **34.8** | 32,709 | **43.6** | 40,232 | **51.7** | 38,242 |
| 1991–1995 | | | | | 38.8 | 40,144 | 49.8 | 38,221 |
| 1996–2000 | | | | | 34.8 | 41,217 | 45.7 | 47,863 |
| 2001–2005 | | | | | | | 40.3 | 40,843 |
| 2006–2010 | | | | | | | 39.2 | 32,116 |
| Total | 56.8 | 99,227 | 54.0 | 147,950 | 49.8 | 237,933 | 51.7 | 288,860 |

[a] Working age immigrants from all source countries, including English speaking countries, were included.

Because immigrants who came from countries in which English is used as one of their official languages (e.g. India) might speak better English at arrival, we created a dummy variable *English as an official language* in this analysis. It was coded "1" if the country of origin used English as an official language, and "0" if otherwise. We relied on the CIA's (2004) *The World Factbook* to create this variable. We also controlled for *linguistic distance* using a scale developed by Snow (1998).[5] The variable was grand mean centered.

To capture the effect of linguistic environment, we created a measure of minority language concentration. Following Chiswick and Miller (2002), we assigned each respondent a measure equaled to the percentage of the population aged 5 and above in the metropolitan area (or rural county if the locality was not identified as a metropolitan area) in which s/he lived who reported the same non-English language as the respondent.[6] The variable was grand mean centered.

### 2.2. Analytic strategy

Empirical research aiming to simultaneously consider assimilation, cohort, and period effects has to deal with the identification problem. Similar to the identification problem in age–period–cohort analysis (Firebaugh, 1997), years since migration, year of entry, and year of survey are linearly dependent of each other. Knowing two of them totally determine the value of the third. Most previous studies try to bypass the problem by ignoring either period or cohort effects. However, it has been argued that ignoring one of the three would result in biased estimates for the rest two if all three effects exist (Firebaugh, 1997).

This study addresses the assimilation–cohort–period identification problem by using micro data, nonlinear transformation of years since migration, and multilevel modeling. First, years since migration is measured by single calendar years while arrival cohorts are defined by 5-year intervals according to the reported year of entry. Years in which surveys are conducted represent time periods. In this way, two immigrants who belong to the same 5-year arrival cohort and are captured in the same survey year could have different values for the duration in the US. However, year of migration is reported in intervals of various lengths in the 1980 and 1990 census data. By using the midpoint of the intervals, it is difficult to derive exact information on years since migration for immigrants surveyed in 1980 and 1990. We use multilevel modeling to further solve the linear dependency problem. The multilevel modeling framework models period and cohort effects as random effects rather than fixed effects additive to assimilation effects (Yang and Land, 2008). Without assuming linearity and additivity of the three variables, the random effect model helps deal with identification problems (Zheng et al., 2011). In addition, this study specifies a model of English fluency as a quadratic function of years since migration. This nonlinear specification not only serves the purpose of solving the linear dependency problem (Firebaugh, 1997), it is also consistent with prior findings of curvilinear relationship between years since migration and English fluency (Carliner, 2000).

Pooling data from all four surveys, a crosstab table can be generated with cohorts as rows and survey years as columns (Table 1). In Table 1, each cell contains immigrants belong to a specific 5-year arrival cohort and were captured in a specific survey year. Immigrants who belong to the same arrival cohorts are selected by the same admission criteria and are

[5] According to Snow (1998), the distance between English and a non-English language increases in the following order: Dutch (1), German (2), Scandinavian (3), Romance (4), Slavic (5), other Indoeuropean (6), and non-Indoeuropean (7).

[6] In constructing this variable, we considered the following language groups: German, Yidish, Dutch, Italian, French, Spanish, Portuguese Greek; Russian; Polish; Serbo-Croatian; Armenian; Persian; Hindi; Hungarian, Chinese, Japanese, Korean, Vietnamese, Arabic, and Hebrew. We grouped remaining languages into African languages, Native India languages, other Scandinavian, other Indo-European languages, other Slavic languages, other Pacific languages, other Asian languages, and unspecified languages.

influenced by the same set of policy regulating their adaptation. As a result, they are likely to be more similar to each other than a randomly selected group of immigrants. Ignoring these similarities will lead to possible false positive results (Raudenbush and Bryk, 2002; Yang, 2008; Yang and Land, 2008). As argued in a previous section, each survey year represents a unique historical period that influences every individual's experiences. The cohort membership and historical period define two macro-level social historical contexts within which each immigrant obtains English. In other words, immigrants can be considered as nested within, and cross-classified by, their cohort membership and survey year. To take this embedment into consideration, we apply an analytical strategy that treats contextual effects of cohort and period as random effects in a cross-classified random effect model (CCREM) (Yang and Land, 2008). The CCREM model has recently been applied to repeated cross-sectional data analysis (mainly age–cohort–period analysis) and has been proven quite useful (Yang, 2008; Yang and Land, 2008). Another reason that we choose this analytic strategy over different alternatives, especially a fixed effect model in which the effects of cohort membership and survey years are captured by a set of dummy covariates, is that the random effect multilevel modeling does not assume linearity and additivity of assimilation, cohort, and period effects and thus it can help solve the identification problem discussed earlier.

Within cell model:

$$\log\left[\frac{p(y_{ijk}=1)}{p(y_{ijk}=0)}\right] = \beta_{0jk} + \beta_{1jk}YSM_{ijk} + \beta_{2jk}YSM_{ijk}^2 + \sum_{p=3}^{P}\beta_{pjk}X_{pjk} \tag{1}$$

where $y_{ijk}$ indicates English ability status (speak only English or speak English very well vs. speak English well, not well, and not at all) for immigrant $i$ who belongs to the $j$th arrival cohort and was captured in the $k$th survey year. We use a logit link to model the expected probability of speaking English very well. $\beta_{0jk}$ is the cell intercept indicating the adjusted mean log odds of English fluency for the reference group who belongs to cohort $j$ and is surveyed at period $k$. $\beta_{1jk}$ denotes the cohort- and period-specific linguistic assimilation effect for the reference group. $\beta_{2jk}$ denotes the cohort- and period-specific deceleration/acceleration effect for the reference group. $X$ represents the vector of other individual-level variables such as age at migration, educational attainment, place of origin, English as an official language, linguistic distance, and minority language concentration. $\beta_{pjk}$ represents the coefficients for covariates in the $X$ vector where $P$ is the maximum number of covariates in the model.

Between cell models:

$$\beta_{0jk} = \gamma_0 + c_{0j} + t_{0k} \tag{2.1}$$

$$\beta_{1jk} = \gamma_1 + c_{1j} \tag{2.2}$$

$$\beta_{rjk} = \gamma_r \text{ where } r = 2 \text{ top} \tag{2.3}$$

Eq. (2.1) is the model for the population cell intercepts – the cohort- and period-specific mean log odds of English fluency when all other variables are 0. $\gamma_0$ is the adjusted mean log odds of speaking English very well for a typical cohort at a typical year. $c_{0j}$ is the deviation of log odds of fluency for cohort $j$ from the typical cohort. $t_{0k}$ captures the deviation of log odds of fluency for period $k$ from the typical period. Accordingly, the variance for the $j$ random cohorts is $\tau_{c0}$, and that for the $k$ periods is $\tau_{t0}$. A significant non-zero $\tau_{c0}$ and $\tau_{t0}$ would support the hypotheses 2 and 4 about the existence of cohort and period effects.

Eq. (2.2) is the model for the population cell slopes: the cohort- and period-specific assimilation rates. $\gamma_1$ is the assimilation effects for a typical cohort . $c_{1j}$ is the deviation of assimilation effect for cohort $j$ from the typical cohort. The variance for the $j$ random cohort-specific assimilation rates is $\tau_{c1}$. A significant non-zero $\tau_{c1}$ would support hypotheses 3 about the existence of cohort variation in assimilation effects.

Based on findings of supplemental analyses and for the sake of model parsimony, a common assimilation rate across survey periods is assumed; the deceleration/acceleration in assimilation rate is modeled as constant across cohorts and periods; and the covariance between initial fluency and assimilation rates is modeled as null. Effects of other level-1 covariates are modeled as fixed across cohorts and periods (Eq. (2.3)). Both the period and cohort random variance components for the intercept and assimilation rates are assumed to have multivariate normal distributions (Raudenbush and Bryk, 2002). We used SAS PROC GLIMMIX (Littell et al., 2006) for the estimation.

## 3. Results

Table 1 reports the percentage of working age immigrants who are fluent in English by arrival cohorts and survey years as well as the sample size in each cell. Cohorts arriving before 1980 were captured in all survey years, while newer cohorts were not found in survey years before their arrival. The bottom row shows the overall average fluency level across time periods. It seemed that overall English fluency declined from 1980 to 2000, but slightly rebounded in 2010. This overall trend represented the joint effect of individual immigrants' assimilation process and historical changes across cohorts and time periods.

In Table 1, each row describes English fluency for an arrival cohort over the years. For example, in 1980, only 35.4% of immigrants who arrived between 1976 and 1980 spoke English very well. The percentage increased to 51 in 1990, 54.6 in 2000, and 57.1 in 2010. It seemed that all arrival cohorts had experienced increases in English fluency as they stayed

longer in the US. We have to be careful, however, in attributing this progress to the pure effect of assimilation. For one thing, immigrants with poorer English were more likely to have returned home. It was also possible that there were variations in macro social historical context such as changes in immigrants' linguistic environment that have slowed down the assimilation process for all cohorts at a given period. In Table 1, it seemed that most cohorts made a smaller advancement in the 1990s than in the 1980s and 2000s.

In Table 1, each column presents cross-sectional information on average fluency across cohorts. Within each cross-sectional survey, fluency seemed to be greater for earlier cohorts than newer ones. For example, in 2010, over 90% of immigrants arriving before 1960 were fluent in English. The percentage declined gradually. For the newest cohort (2006–2010 arrivals), it was only about 39%. This cross-sectional comparison captured different cohorts at different durations in the US. With longitudinal data, we can compare cohorts at a given length of residence in the US, for example – shortly after arrival. In the 1980 census, 35.4% of the newest immigrant cohort (having arrived between 1976 and 1980) spoke English very well. The percentages were similar for the new arrival cohorts in the 1990 and 2000 censuses (both

**Table 2**
Assimilation, cohort, and period effects on immigrants' English fluency for working age immigrants from non-English speaking countries ($n$ = 677,924).

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | Odds ratio | Coefficient | Odds ratio | Coefficient | Odds ratio | Coefficient | Odds Ratio | Coefficient | Odds ratio |
| Intercept | −1.037*** | | −0.960* | | −0.508* | | −0.405* | | −0.530* | |
| Years since immigration | 0.070*** | 1.07 | 0.056*** | 1.06 | 0.054*** | 1.06 | 0.052*** | 1.05 | 0.053*** | 1.05 |
| Years since immigration[b]/100 | −0.070*** | 0.93 | 0.033** | 1.03 | −0.068*** | 0.93 | −0.068*** | 0.93 | −0.068*** | 0.93 |
| Age at immigration | | | | | −0.080*** | 0.92 | −0.080*** | 0.92 | −0.080*** | 0.92 |
| Age at immigration[b]/100 | | | | | 0.172*** | 1.19 | 0.172*** | 1.19 | 0.174*** | 1.19 |
| Male | | | | | −0.009 | 0.99 | −0.004 | 1.00 | −0.003 | 1.00 |
| Education | | | | | 0.230*** | 1.26 | 0.230*** | 1.26 | 0.230*** | 1.26 |
| Education[b] | | | | | 0.013*** | 1.01 | 0.013*** | 1.01 | 0.013*** | 1.01 |
| Mexico | | | | | −1.293*** | 0.27 | −1.398*** | 0.25 | −1.185*** | 0.31 |
| Cuba | | | | | −1.001*** | 0.37 | −1.083*** | 0.34 | −0.706*** | 0.49 |
| Other Central America | | | | | −0.805*** | 0.45 | −0.918*** | 0.40 | −0.741*** | 0.48 |
| South America | | | | | −0.629*** | 0.53 | −0.730*** | 0.48 | −0.561*** | 0.57 |
| China | | | | | −1.332*** | 0.26 | −0.395*** | 0.67 | −0.383*** | 0.68 |
| Korea | | | | | −1.256*** | 0.28 | −0.319*** | 0.73 | −0.327*** | 0.72 |
| Other East Asia | | | | | −0.575*** | 0.56 | 0.379*** | 1.46 | 0.372*** | 1.45 |
| Philippine | | | | | 0.329*** | 1.39 | 0.271*** | 1.31 | 0.235*** | 1.26 |
| Vietnam | | | | | −1.442*** | 0.24 | −0.512*** | 0.60 | −0.513*** | 0.60 |
| Other Southeast Asia | | | | | −0.798*** | 0.45 | 0.057* | 1.06 | 0.047* | 1.05 |
| India | | | | | 0.172*** | 1.19 | −0.818*** | 0.44 | −0.851*** | 0.43 |
| Other South Asia | | | | | −0.319*** | 0.73 | −0.493** | 0.61 | −0.497*** | 0.61 |
| Middle East | | | | | 0.047* | 1.05 | 0.836*** | 2.31 | 0.830*** | 2.29 |
| Africa | | | | | 0.562*** | 1.75 | 0.875*** | 2.40 | 0.914*** | 2.49 |
| Other | | | | | 0.149*** | 1.16 | −0.067** | 0.94 | 0.027 | 1.03 |
| English as official language | | | | | | | 0.993*** | 2.70 | 1.037*** | 2.82 |
| Linguistic distance | | | | | | | −0.350*** | 0.70 | −0.352*** | 0.70 |
| Minority Language Concentration | | | | | | | | | −1.175*** | 0.31 |
| *Variance components for random effects* | | | | | | | | | | |
| Cohort effects[a] | | | | | | | | | | |
| Intercept ($\tau_{c0}$) | 0.046* | | 0.097* | | 0.009 | | 0.006 | | 0.005 | |
| Assimilation rate ($\tau_{c1}$) | 0.0003* | | 0.0004* | | 0.00003 | | 0.00003 | | 0.00003 | |
| Period effects ($\tau_{t0}$) | | | 0.103 | | 0.040 | | 0.027 | | 0.025 | |
| *Estimated probability of speaking English very well at 16 years of residence in the US for each period* | | | | | | | | | | |
| 1980 | | | 0.51 | | 0.59 | | 0.60 | | 0.56 | |
| 1990 | | | 0.53 | | 0.58 | | 0.59 | | 0.57 | |
| 2000 | | | 0.46 | | 0.54 | | 0.56 | | 0.53 | |
| 2010 | | | 0.36 | | 0.48 | | 0.50 | | 0.48 | |
| Goodness of fit[b] | 929,248 | | 928,664 | | 701,939 | | 694,904 | | 693,335 | |

[a] Due to the large amount of statistics, the estimated fluency at entry and assimilation rate for each cohort calculated from the cohort random effect are reported in Figs. 2 and 3.

[b] Although all fixed and random effects were estimated by pseudo-likelihood, the model fit statistics were based on −2 restricted maximum likelihood from the normal hierarchical linear model (Littell et al., 2006; Yang, 2008).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

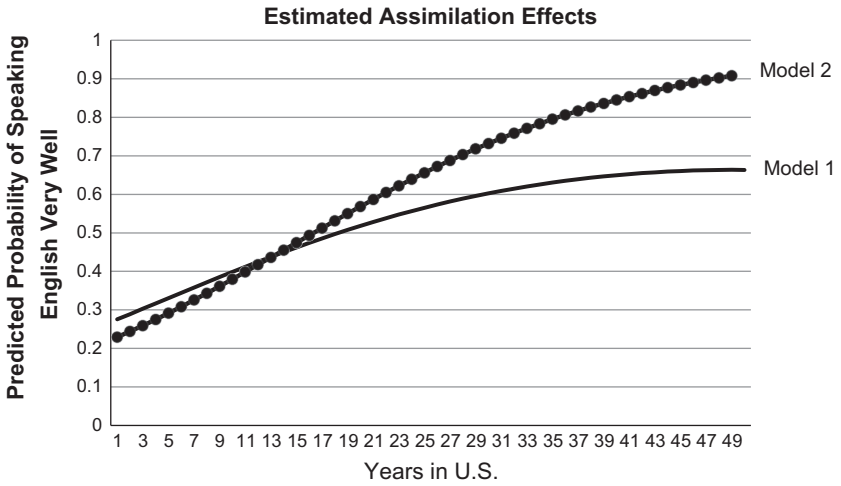


**Fig. 1.** Overall assimilation effects.

are 34.8% after rounding). In the 2010 ACS, the percentage was actually higher (39.2%). It seemed that there was no clear sign of decrease in initial fluency among cohorts who arrived after 1975.

However, if we compare cohorts at 10 years of residence in the US (statistics in rectangles), the percentages of speaking English very well for the 1976–1980 arrivals was slightly lower than the 1966–1970 arrivals but was much higher than the 1986–1990 arrivals. The declining trend did not extend to the 1996–2000 arrivals. Comparing English fluency at 20 years of residence in the US (shaded cells), it seemed that earlier cohorts achieved higher levels of English fluency than newer cohorts. However, immigrants obtain English fluency in a social and linguistic environment that was changing and evolving over time. If macro environments in the past were more facilitating for immigrants to make progress, the observed advantages of earlier cohorts might actually reflect the changes in the environments.

Focusing on the 1976–1980 and the 1986–1990 arrivals (bold cells), the two cohorts started with similar fluency levels (35.4 vs. 34.8). The 1976–1980 arrivals made a much greater progress in their first 10 years of assimilation during the 1980s (51.0 − 35.4 = 15.6) than did the 1986–1990 arrivals during the 1990s (43.6 − 34.8 = 8.8). However, the 1976–1980 arrivals did not made as much progress in their second decades of residence in the US during the 1990s (54.6 − 51.0 = 3.6) as did the 1986–1990 arrivals during the 2000s (51.7 − 43.6 = 8.1). It seemed that both cohorts slowed down during the 1990s.

As stated in Section 2, we used cross-classified random effect models (CCREMs) to disentangle different sources of temporal variations. To illustrate how confounding the three temporal changes would lead to incorrect interpretations, Model 1 in Table 2 estimated assimilation and cohort effects without considering period effects. The overall assimilation effect was statistically significant. Fig 1 visually presents the overall assimilation trend in terms of predicted probabilities of speaking English very well estimated in Model 1.[7] Although immigrants from non-English speaking countries started with a low probability of speaking English fluently (0.25), their ability to speak English increased over time but with a decelerating rate. After 15 years of stay, the probability was about 0.45. However, the pace that immigrants pick up English was not very encouraging. After 45 years of stay, the probability of being a fluent English speaker was only about 0.67.

Did this result confirm the common complaint that immigrants are not willing to assimilate, or there was something else that prevented them from making rapid progress? We added period effects in Model 2. The results were presented also in Fig 1.[8] It seemed that period effects significantly suppressed immigrants' attainment of English fluency over time. In other words, if the social and linguistic environments had been more facilitating, immigrants would have made greater gains over time.

Model 1 also estimated a unique intercept and an assimilation rate for each arrival cohort.[9] The left panel of Fig. 2 displays the predicted probabilities of speaking English very well for successive cohorts evaluated at the year of entry, 10 years, 20 years, and 30 years in the US. It seemed that immigrants who arrived after 1965 did not make progress as big as pre-1965 cohorts. Immigrants who arrived between 1965 and 1990 followed a declining trend in their English attainment. It was noteworthy that there was an upturn in the estimated overall English attainment started from 1990. With respect to fluency at the entry year, there was no clear trend but irregular fluctuations.

[7] The predicted log-odds, denoted as $\eta$, were converted to predicted probabilities, denoted as $p$, by: $p = 1/(1 + \exp(-\eta))$ (Raudenbush and Bryk, 2002). As $\eta$ approaches infinity, the predicted probability approaches 1.

[8] Although the coefficients for the quadratic term of years since migration was negative in Model 2, transformed into probabilities, they displayed a pattern that immigrants obtain English fluency at a decelerating rate.

[9] The effect for cohort $j$ was computed by adding corresponding random cohort residual $\hat{c}_{0j}$ to the estimated overall mean $\hat{\gamma}_0$ Similarly, the effect for period $k$ was computed by adding the corresponding random period residual $\hat{t}_{0k}$ to the estimated overall mean $\hat{\gamma}_0$ (Eq. (2.1)).

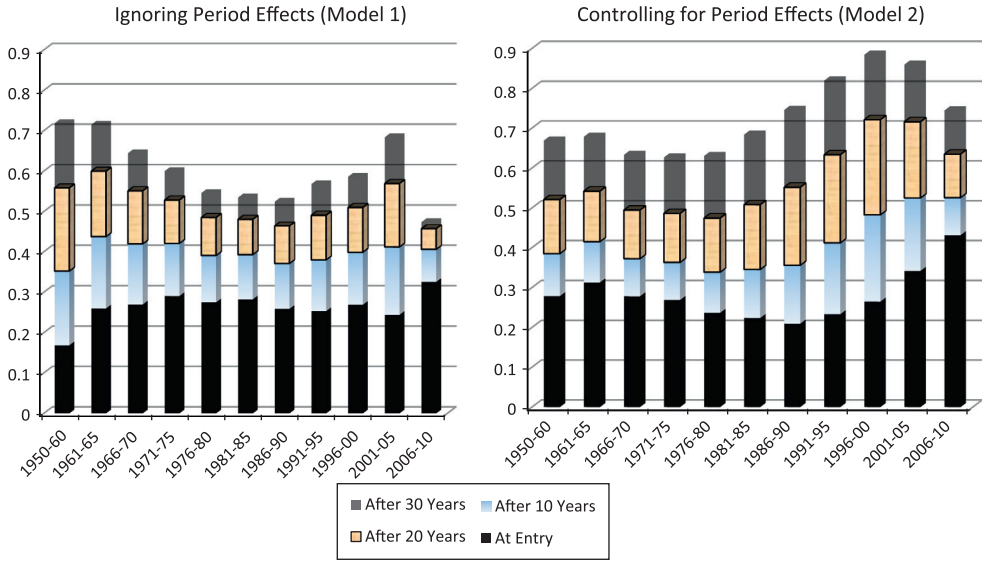


**Fig. 2.** Predicted probability of speaking English very well at entry, after 10, 20, and 30 years in US by cohorts.

Should we attribute these cohort differences to cohort characteristics resulted from historical changes in immigration flow and admission criteria? Or was it possible that changes in macro-linguistic environment hindered the assimilation of recent cohorts? If there were no period effect, considering period effects would bring few changes to the results. However, adding period effects in Model 2 revealed a different picture about cohort variations which were reported in the right panel of Fig. 2. Taking away the effects that should be attributed to periodical social changes, recent cohorts actually made much faster progress than earlier ones and their advantages over earlier cohorts were obvious. Net of period effect, immigrants who arrived during the 1990s had lower fluency at entry compared to pre-1965 cohorts, but they would have quickly caught up after 10 years of stay in the US. Immigrants who arrived during the 1980s would have also caught up with pre-1965 cohorts after 20 years of assimilation. Comparing the two panels in Fig. 2, it seemed obvious that period effects suppressed the advantages of recent cohorts.

The two panels in Fig. 2 display different patterns for the cohort-specific fluency at the year of entry which was the estimated cohort-specific intercepts. At the year of entry, the value for the variable, years since migration, was 0, but immigrants' actual duration in the US could range from a few days to 11 months. Although the levels of fluency at the very point of entry were associated mainly with pre-migration factors, linguistic environments in the host society would start to affect

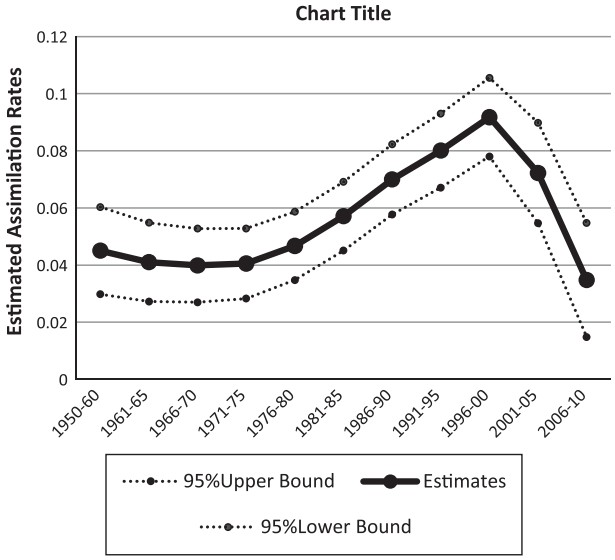


**Fig. 3.** Assimilation rates by arrival cohorts (Model 2).

immigrants on the first day after they arrive. Therefore the estimation of cohort specific intercepts was not free of the influence of period effects if there were any. Controlling for period effects, the right panel in Fig. 2 reveals a clear pattern in fluency at the year of entry. There seemed to be a decline started from 1966 and extended to 1990.[10] However, started at early 1990s, there was a strong upturn in the initial fluency level. The fluency level at entry for the most recent cohort (2006–2010 arrivals) was the highest among all cohorts. It seemed that changes in immigration law made a difference. The decline between 1966 and 1990 possibly reflected the effect of the 1965 Immigration and Nationality Act in which the admission priority was given to family reunion. The strong upturn that started at 1990 possibly reflected the Immigration Act of 1990, which raised the share of visas allocated on the basis of skill sets.

To better see cohort differences in their assimilation rates, we compare directly in Fig. 3 cohort specific assimilation rates estimated in Model 2. As shown in Fig. 3, recent cohorts had increasingly higher assimilation rates except for those arrived after 2000. The 1996–2000 arrivals had the fastest assimilation rate. The newest cohort had the slowest assimilation rate, although their initial fluency level was higher than other cohorts. Was the sudden drop in assimilation rates during the 2000s an indicator of a new decline or just a transitional abnormity? Future studies are needed to examine the changes.

Were the reported net cohort differences statistically significant? The estimated variances for cohort specific intercepts and assimilation rates were reported in the middle panel of Table 2. The non-zero variances for the intercepts and assimilation rates were both statistically significant ($\tau_{c0} = 0.097$; $p < .05$; $\tau_{c1} = 0.0004$; $p < .05$ in the middle panel of Model 2). These non-zero variances indicated differential language assimilation trajectories across cohorts. We replicated Models 1 and 2 with fixed effect models and found similar results.

If period effects had suppressed immigrants' attainment of English fluency in general and the advantages of recent cohorts in particular, how were the four time periods different from each other? Model 2 estimated a unique effect for each time period. The estimated probabilities of speaking English very well evaluated at the sample mean length of stay (16 years) for each survey year were reported at the bottom panel of Table 2. It seemed that for an immigrant who belonged to a typical cohort and assimilated at a typical rate with 16 years of duration in the US, the probability that s/he spoke English very well was slightly higher if s/he was surveyed in 1990 (0.53) than in 1980 (0.51). However, if such a person was captured in 2000, the probability was much lower (0.46). Above and beyond assimilation effects and cohort variations, an immigrant would have the lowest probability to be a fluent English speaker if s/he was evaluated in 2010 (0.36). Model 2 reports the estimated variance for periods ($\tau_{t0} = 0.103$), which was not statistically significant. Although past simulation studies have confirmed that the CCREM model produces consistent and efficient estimates even with five waves of data, theoretically, a large number of cross-sectional surveys are needed for the validity of statistical inferences (Yang and Land, 2008). To evaluate the possibility that the small number of periods observed in the study limited the statistical power, we replicated the analyses treating period effects as fixed effects. We detected almost identical period effects. The fluctuation from 1980 to 1990 was not statistically significant in the fixed effects model, but the declines from 1990 to 2000 and from 2000 to 2010 were highly significant (results available upon request).

Model 3 in Table 2 controlled for age at migration, sex, years of education, and place of origin. As expected, higher educational attainment and a younger age at migration increased the odds of speaking English very well.[11] Compared to immigrants from non-English speaking countries in Europe (the reference group), those from Latin America and most parts of Asia had lower odds of speaking English fluently while immigrants from Africa and Middle East had higher odds. Being a Mexican immigrant reduced the odds of speaking English very well by 73% ($100 * (\exp(-1.293) - 1) = -73$) compared to immigrants from European non-English speaking countries. Being a Chinese immigrant reduced the odds of speaking English very well by 74%. Similar effects were found for Korean and Vietnamese immigrants. Sensitivity analysis suggested that the relatively lower English fluency among Mexican immigrants appeared to be partly due to their relatively lower levels of human capital, mainly educational attainment. This was consistent with literature noting that while only the more educated in distant countries know about job opportunities in US and can afford to migrate, immigrants from nearby areas are less selective. On the other hand, being an Indian or Philippine immigrant increased the odds of speaking English very well by 19% or 39%, respectively. Both countries define English as one of their official languages. It seemed that the pre-migration exposure to English made differences.

Adding Human capital variables and place of origin variables reduced the residual cohort variance at arrival by 91% (from 0.097 to 0.009). They also explained away cohort variation in assimilation rates (variance reduced from 0.0004 to 0.00003).This was consistent with literature that states human capital and places of origin account for much of the cohort variations in immigrants' language skills and economic performance (Borjas, 1995; Carliner, 2000). Human capital variables and place of origin variables also reduced the residual period variance by 60% (from 0.103 to 0.040). This was reasonable because immigrants from some sending regions (e.g. Latin America) were more likely to reside in ethnic enclaves than immigrants from other regions (e.g., India).

[10] Carliner's (2000) study did not consider cohort differentials in assimilation rates. In his study, cohort differences stay the same at entry and after some years in the US. Therefore, they were not directly comparable to those reported in the right panel of Fig. 2. Cohort effects estimated in a comparable model indicated that there was a slight decline after 1965, stagnancy during 1970s, and then strong upturn started in the 1980s (results available upon request).

[11] Differentials in human capital such as education and age at migration would affect the assimilation process after arrival. Not reported in Table 2, we also tested interaction effects between years in US, education, and age at migration. We found that assimilation rates were higher for those with more education and who came to the US at a younger age.

Controlling for linguistic distance and English as official language in the society of origin in Model 4 further reduced the residual variance for cohort specific initial fluency (from 0.009 to 0.006). These two variables explained away much of the disadvantages of immigrants from Eastern Asia. Moreover, immigrants from the Middle East would have had even better English skills if the distance between their mother tongues and English were not as large. Without directly measuring linguistic distance, Carliner (2000) argued that linguistic distance was not as important as other factors. His claim was based on observations that Spanish was closer to English than languages such as Arabic, but Mexicans had poorer English speaking ability. Directly estimating the effect of linguistic distance and controlling for human capital variables, this study found evidence that linguistic distance could not be ignored.

In the last model, minority language concentration was included to capture the effect of immigrants' language environment. As expected, the higher the minority language concentration in their area, immigrants' fluency levels were lower. Comparing Model 5 and Model 4, language environment variables further explained away a small portion of disadvantages of Latin American immigrants. Comparing variance for period effects across models, it reduced by two thirds (from 0.103 in Model 2 to 0.025 in Model 5). In a sensitivity analysis, we dropped human capital variables, places of origin, linguistic distance, and English as official language but kept minority language concentration alone in the model. We found that minority language concentration was associated with one third of the variation in period effects. We replicated Model 5 treating period effects as fixed and found that the decline from 1990 to 2010 was still statistically significant. Additional analysis focusing on Mexican immigrants also revealed the advantages of recent cohorts and suppressive period effects after 1990.

## 4. Conclusions

Because of the surge in immigration to the United States during the recent decades, a longstanding debate about the extent and the rate of assimilation has been revived. Among different facets of immigrants' assimilation, their ability to speak English has drawn a lot of attention. It has been well established that English language proficiency is a crucial human capital that facilitates economic mobility within the United States. Immigrants' ability to speak English is also associated with their residential integration and participation in civic life. English fluency is therefore an important step in a broader process of integration. Using 1% sample of the 1980, 1990, 2000 US census data and the 2010 ACS, this study examined the English language fluency of working age immigrants in the US. By including recent census data in the analysis, we analyzed both historical and recent patterns in English language skills. More important, this study advanced the research on immigrants' English skills by disentangling three simultaneously longitudinal trends: assimilation trajectory, cohort variation and period differences. The main findings from this study are as follows.

First, this study confirmed the conclusions made by previous studies that although most immigrants did not speak English very well at arrival, they picked up English as they stayed in the US. Net of cohort and period effects, the assimilation effect was strong. Second, we detected a temporal decline in English fluency mainly from 1990 to 2010 above and beyond assimilation and cohort effects. Although immigrants are assimilating, the macro environments suppressed their advancement.

With new census data, we found that the declining cohort trend in initial English fluency reported in a previous study based on 1980 and 1990 data (Carliner, 2000) was reversed in the 1990s and 2000s. These findings echoed a recent study on immigrants' economic performance which found that the declining trend in the relative earnings of successive immigrant cohorts was reversed during the 1990s (Borjas and Friedberg, 2009). We also found that recent cohorts, except for the newest two, assimilated at increasingly higher rates than earlier cohorts. However, their advancements were suppressed by the changes in the macro environment. If there had been no period effects, immigrants who arrived after 1990 would have had quickly caught up with pre-1965 cohort and eventually had higher levels of English fluency.

Controlling for period effects, the advantages of recent immigrants were obvious. The cohort effects were largely explained by information on human capital and place of origin. Together, they explained 91% and 93% of cohort variations in English fluency at entry and English attainment rates, respectively. However, our findings suggest that we should not apply the well circulated interpretation that earlier immigrants from Europe have higher level of quality or skills than newer ones from Latin American and Asia. The rapid increase in the initial fluency level since 1990 would reflect the increase in new arrivals' human capital as a result of changes in immigration policy. The Immigration Act in 1990 emphasized human capital possessed by immigrants as one of the admission criteria (Borjas and Friedberg, 2009). It needs to be pointed out that both the absolute years of schooling of new immigrants and that relative to natives have increased during the 1990s (Borjas and Friedberg, 2009). Our additional analysis indicated that 57% of the newest cohort in 1980 had 12 or more years of education. The percentage was 62.1 in 1990, 65.0 in 2000, and 76.8 in 2010. The increasing trend in human capital among new arrivals would contribute to their advancement in English fluency. The increase in the initial fluency level would also indicate the spread of English as an international language and the diffusion of American culture (Carliner, 2000).

Because the periodical decline from 1990 to 2010 were significant even after controlling for variables such as human capital variables, places of origin, and minority language concentration, it was possible that there were unmeasured factors that contributed to the changes in immigrants' social and linguistic environment that hindered their advancement in English fluency. According to the literature, one such factor could be the increasing gap between demands and resources for English language instruction programs (Myers and Pitkin, 2010; Pitkin and Myers, 2011). Steadily high levels of immigration during the past few decades have greatly increased the demands for adult English language literacy training programs. As Congress has recognized, the gap between the demand and the availability of such programs has increased since the 1970s (Congress,

2006) and the inadequate funding for these programs has constituted a key barrier to immigrants' linguistic assimilation process (Congress, 1992). Unfortunately, we were unable to evaluate the effect of this factor due to the lack of reliable measurements. Other factors might include the tougher measures against undocumented immigrants in the past two decades, the Arizona law and similar ones across the US, and the resurrection of the English-only movement. Together with the decreased accessibility of English language instruction programs, these social changes might have pushed those who need to improve their English skills further into isolation and hindered their assimilation process.

The three temporal trends combined to explain the overall changes in the average English fluency levels reported in the bottom row in Table 1. Had the macro environments been more supportive, we would have observed an earlier and greater rebound in overall trends in English fluency.

Though our findings provide useful insights on immigrants' linguistic assimilation, there are several limitations that might affect the findings of this study. First, using synthetic cohorts, it is impossible to separate the assimilation effects from the confounding selective return in this study. If immigrants who do not speak English very well are more likely to return to their home countries, or short-time temporary immigrants are less likely to invest in English attainment, the assimilation effect would be biased up. Indeed, our additional analysis indicated a possible association between attrition and educational attainment. The better educated are more likely to stay in the host society and survive to an older age. They are also more likely to speak better English. Although previous studies suggested that immigrants with weak English skills do not have higher probability to return to their home countries than others (Stevens, 1994), without panel data, we were unable to evaluate the effect of return due to poor English.

Second, although the inclusion of the 2010 ACS enabled us to detect more recent trends, it has been suggested in the literature that English fluency might be under reported in ACS compared to the censuses (Myers and Pitkin, 2010). Because ACS has a higher proportion of in-person interviews in data collection compared to census, the presence of an interviewer might have lead to a more conservative evaluation of English fluency. Therefore, the period effect for 2010 reported in this study might have been biased down due to the interviewers' effects.

Moreover, the lack of exact information on years since migration for immigrants surveyed in 1980 and 1990 would introduce measurement errors in this variable. This might affect the estimation of assimilation trajectories of earlier cohorts. Because the measurement error in years since migration would be greater for immigrants surveyed in 1980 and 1990, it was uncertain how this unevenness would affect the estimated assimilation, cohort, and period effects.

As a conclusion, we suggest that the argument that immigrants are not assimilating is questionable. Immigrants are assimilating. However, the macro environment had suppressed their linguistic assimilation process. If the environment were more facilitating or supportive, immigrants would have made much greater progress. When the host society was hostile to immigrants who cannot speak fluency English and at the same time was not willing to invest in English training programs, it was possible that immigrants who lacked English fluency would be pushed further into linguistic isolation and took shelters in ethnic enclaves. The lack of proper measurements limited our ability of pinpoint causes for the detected period effects. Future studies should examine different sources of changes in social and linguistic environment in the US that have shaped the advancement of immigrants' English fluency attainment.

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