Age-of-Arrival Effects on the Education of Immigrant Children: A Sibling Study

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Abstract: We analysed the effects of late entry on the human capital of immigrant children, and investigated the channels via which age-at-migration affects the native-immigrant education gap. Ordinary-least-squares estimates could have been biased if parents factored the age of children into their migration decision. Using a sample of siblings from the 2000 US Census, we employed a family fixed-effects estimation strategy and found a negative and convex relationship between human capital and age-of-arrival. Teenage entrants’ outcomes were worst affected compared to younger entrants. Language was found to be an important mediating factor via which age-of-arrival influenced education. The critical age for English proficiency was 8-10. Age-of-arrival affected education not only through language but also via heterogeneous origin country conditions. The additional privileges of birth-right citizenship, if any, were disentangled from the benefits of zero age-of-arrival for natives. Citizenship by birth provided few advantages, except for college enrollment. Results were robust to sample selection changes.

Keywords: Age-of-arrival · Education · Immigrant children · Sibling study · Family fixed-effects.

JEL Classification: I20 · J1 · J13 · J15.

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Introduction

The Immigration and Nationality Act of 1965 relaxed national origin restrictions on the flows of immigrants to the US. The foreign-born population in the US surged from 4.7% in 1970 to 13% in 2010 and the source countries shifted away from Europe in favour of Latin America and Asia (Pew Research Centre 2015). Debate about the socio-economic assimilation of the foreign-born population has re-emerged. The education gap between natives and immigrants has been well-documented. The 2010 US Census bureau report on education stated that almost 90% of natives completed high-school. Only 60% of adult and 67% of child immigrants has a high-school or equivalent degree. The relationship between education and economic outcomes has been well-established (Mincer 1974), and the educational disadvantage could translate into a labor market disadvantage.

We investigated the benefits of a younger age-of-entry into the US on human capital development for immigrant children, and searched for the sources of these benefits. Early experiences have been shown to have a uniquely powerful influence on the development of language and other cognitive and social skills (Lennenberg 1967). A large body of literature has focused on the impact of late arrival on the human capital of immigrants. Older entrant children spend a large part of the “critical period” of development outside the host country. Age-of-arrival has been seen to affect English proficiency (Bleakley and Chin 2004) or the use of a foreign language at home (Glick and White 2003), and thus has been linked to school performance. Delayed age-of-entry, additionally implies less exposure to the US culture and education system, and can affect test scores (Cortes 2002). Contrarily, extended exposure to home-country conditions, if poor, could worsen outcomes in the host country (Åslund et al. 2015). Indeed, Chiswick and DebBurman (2004) found that teenage

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1 An immigrant is an individual born outside the 50 US states and the district of Columbia, including those born in US territories. People born abroad to American parents are excluded. In this work, the terms immigrant and foreign-born were used interchangeably.
immigrants arriving to the US usually receive less education than pre-teen or adult immigrants.

Previous research that employed an ordinary least squares (OLS) approach to study the effects of age-of-arrival or immigrant generation on education attainment may fail to account for household selection. For example, parents who migrated with young children may have had different levels of education, income, and capability of investing in their children’s education than parents who migrated with older children. If parental migration motives, child age and schooling decisions in the host country are jointly determined, the OLS estimates of age-of-arrival effects on human capital could have been biased.

Besides an age-of-arrival of zero, US-born natives also have “citizenship by birth,” which could further contribute to the native-immigrant education gap. Some forms of public assistance, like scholarships or loans, are more easily available to citizens. These promote access to higher education. Therefore, some academic disadvantages for immigrants attributed to late arrival may instead be due to lack of citizenship.

Using a sample from the 2000 US Census, we exploited the within-family variation in ages of entry for a sample of immigrant siblings who simultaneously migrated to the US at ages below 18. This approach is similar to Bohlmark (2008), who studied the impact of age-at-immigration on test scores between immigrant and native children in Sweden. A fixed-effect strategy should remove homogenous household effects from age-of-arrival estimates of human capital. Adopting a flexible estimation technique, the effects for all ages of entry from one through 17 were estimated. Those who entered at age zero were treated as the base group. This approach allowed for the identification of critical ages-of-entry and trend breaks in the relationship between age-of-entry and outcomes. Also, to disentangle the benefits of “entry at age zero” and birth-right citizenship, we compared natives to their immigrant siblings who entered as infants. The assumption was that the exposure to

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2 Jus Soli or “citizenship by birth” is a right by which a child has the citizenship of the country in which they were born, and not necessarily the nationality of either parent which is the principle of Jus Sanguinis.
US stimuli is similar for these siblings, though their citizenship status might differ.

Using binary indicators for each age-of-arrival and household fixed effects, we found that the relationship between age-of-arrival and human capital was negative and convex. English ability of infant entrants was comparable to natives. Language skills were worse for older entrants; the critical age was between 8-10. Without controlling for citizenship and English proficiency, education outcomes deteriorated at age-of-arrival 8, which coincided with the critical age of language acquisition.

We proceeded to investigate the sources of the age-of-entry disadvantage for late entrants. The addition of language and citizenship controls showed no significant difference in overall education outcomes for immigrants entering at age 0 and those entering between ages 1 and 12. This implies English proficiency played an important role in determining the worse academic outcomes of pre-teen entrants compared to infant entrants. Even with language and citizenship controls, teenage entrants had worse outcomes at all education levels compared to younger entrants. Besides language fluency, origin countries can differ in education infrastructure and the social importance of education. Exclusion of Mexican households improved average outcomes, whereas exclusion of families from Asia had the opposite effect. Late-arrival also had larger education disadvantages for female teenage entrants vis-à-vis their male counterparts, hinting at sex-based interferences in adolescent development as a result of migration. Finally, despite a citizenship gap between infant entrants and their US-born siblings, there did not seem to be educational advantages accorded by “birth-right citizenship,” except possibly for college enrolment.

Research has emphasized the need to invest in the environments of disadvantaged children during the early childhood years, in order to strengthen the workforce (Phillips and Shonkoff 2000; Knudsen et al. 2006). The proportion of public school students enrolled in “English as a Second Language” (ESL) classes has risen in the last two decades – the National Centre for Education Statistics (2015) states that 9% of students are English-Learners. The need for ESL classes has increased across all
levels of schooling. Our results suggest that pre-teen entrants, particularly those from Mexico, can benefit from ESL classes. However, we also saw that age-of-entry effects are non-linear and extend beyond language acquisition, supporting the need for heterogeneous teaching techniques at different grades in school. Teenage entrants may require assistance beyond language classes, in the form of host-family or mentorship programs like big-brother-big-sister programs that allow them to navigate US society better.

**Econometric Strategy and Identification**

A cross-sectional equation used to capture age-of-arrival effects on human capital outcomes was put forth as follows:

\[ Y_{ij} = \alpha + \beta A_{ij} + Z_{ij} \gamma + \epsilon_{ij} \]  

(1)

where \( i \) denoted a child living in household \( j \). \( Y_{ij} \) denoted the outcome of interest (education, English ability etc.). \( A_{ij} \) was the age-of-arrival of an immigrant and was represented either by binary variables to flexibly approximate the effects or by the actual age at migration to fit a linear trend. As long as ages-of-entry vary across individuals, the effects on outcomes are identified. Other observable child specific characteristics like sex, the type of school, etc. that may affect both age at which the child migrates and the outcome variable were included in \( Z_{ij} \). Birthplace and race of parents could also be included in a cross-sectional regression. These demographic traits can be important – for instance, if immigrant parents from Asian countries that prioritize education arrived in the US with young children.

If equation (1) was estimated via an ordinary least squares (OLS) method, the estimates for \( \beta \) may be affected by omitted variable biases. The error term was decomposed as \( \epsilon_{ij} = F_j + \omega_{ij} \) where \( F_j \) were time-invariant characteristics common across siblings in the same household, like year of
immigration, parental motivation, family income at time of arrival etc. \( u_{ij} \) was a random error term.

Equation (1) was rewritten as:

\[
Y_{ij} = \alpha + \beta A_{ij} + Z_{ij} \gamma + F_j + u_{ij}
\]  

(2)

OLS estimates for \( \beta \) would be biased if age-of-arrival and the fixed-family error were correlated i.e. \( \text{Corr}(F_j, A_{ij}) \neq 0 \) The estimate would also be biased if \( F_j \) is not independent of \( Z_{ij} \).

For children, the decision to migrate was taken by their parents. Younger children were more likely to arrive with young parents. The assimilation patterns of parents could have been influenced by their own age-of-entry and consequently have heterogeneous impacts on younger and older entrant children. Younger parents had more time to familiarize themselves with the US education system and to accumulate more wealth. When the child considered post-secondary education, the family had access to more finances and information, and these manifested as differences in critical period resources among older and younger children of the same household.

Additional sources of bias from unobservable characteristics of parents could have arisen if parents took into consideration a child’s age when they decided to immigrate.\(^3\) The problems of self-selection among adult immigrants have been discussed by Borjas (1985, 1987). Parents who were more concerned about their children’s education could have immigrated with young children. This unobserved motivation could translate into higher investment in child’s education in the host country, biasing age-of-entry estimates. Legality of residence can vary across immigrant parents and influence their ability to migrate with young children. Undocumented immigrants were likely to be from Latin America and the Caribbean (The Department of Homeland Security 2009). Parents who wanted their children to contribute to household finances may have brought older children who

\(^3\) This was also an assumption made by Bohlmark (Bohlmark 2008). Taking the opposite view, van Ours and Veenman viewed age-of-arrival as being exogenous since children merely follow the parents (van Ours and Veenman 2006).
quickly enter the labour market. Seasonal migrant worker parents may have considered themselves temporary visitors to the US, even if their decision later changed. Their children may have lived in ethnic enclaves, attended enclave schools, or not had native friends. Difference in time spent in school or ethnic enclaves are sources of differential critical period stimuli for young and old entrants. Clarke (2016) showed that neglecting the role of parental education overestimates the disadvantages of late entry in cross-sectional linear regressions.

To deal with the possibility that parental selection may bias linear estimates of age-of-arrival on outcome variables, a fixed family effects estimation was used in this paper. Fixed effects can deal with time invariant omitted variable biases, which were common across siblings. Observable characteristics such as country of origin, ethnicity and race, and unobservable traits such as parental attitude towards education, initial wealth and assets, desire to assimilate, parental age-at-migration were all potentially removed. The initial neighbourhood of stay, but not time spent in it, was common across siblings, and we considered time spent as differences in critical period stimuli across children. Once cleaned of homogeneous fixed effects, age-of-arrival effects in equation (2) were identified off intra-household variation in age-of-arrival among siblings. Of course, it is important to understand the extent to which family effects were common are across siblings, which we investigated in our robustness checks.

A possible source of bias in fixed effects estimates was staggered, rather than simultaneous entry, of siblings. Parents may have chosen to bring the “more able” child to US earlier. To deal with this problem, we only considered siblings who entered the country at the same time. Another concern with fixed-effects estimation using siblings’ data was measurement error (Bound and Solon 1999). Since all siblings immigrated in the same year, the extent of misreporting in the age-of-arrival

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4 If parents can afford to bring only one child to US, they will probably be accompanied by the younger child. Conversely, if parents need assistance in the host country, they may bring the older child who enters the labor market soon, and the investment in education will be low.
variable was similar and fixed effects should have removed them. Random measurement error in the outcome variables affected standard errors and not necessarily the unbiasedness of the coefficients.

Age of entry and year of entry are correlated, and both variables could not be included in the same regression. Immigrants in the US have been a heterogeneous group, and immigrant quality, as identified by period of entry, changed across cohorts. Even if ages-of-arrival for two children, of different families, were the same, as long as the earlier cohorts were of “better” quality, then disambiguating cohort effects from age-of-arrival effects is difficult. For instance, the enactment of the Immigration and Nationality Act of 1965 shifted the demographic composition of immigrants from European source countries to Asian and Latin American countries. This created a bimodality in the education distribution of immigrants in the present day, with Asians having high average levels of education and Latin Americans getting less education than natives on average (Card 2009). There was concern that based on the cohort of arrival, parental characteristics have changed and the way the child’s age was factored into the immigration decision had changed. One of the goals of this paper was to understand how children learn language and achieve academically in the US as they stay and we measured their adult outcomes. Since cohort of arrival cannot be included as a control, we restricted the sample to immigrants who have resided in the US for at least ten years.

Fixed effects estimation cannot remove heterogeneous effects across siblings. Policy and institutional changes could have affected incentives associated with continuing education of children. US immigration policy favoured family reunification, hence parents often immigrated with children. While there is no evidence that the US policy favoured parents with younger children, the parents themselves could vary their behaviour across children. For example, a temporary immigrant who eventually became a legal permanent resident may have differentially invested in their older and younger children’s human capital. Fixed effects estimators are sensitive to compensating or reinforcing behaviours by parents.

Economists and psychologists have argued that educational outcomes change by birth-order
(Booth and Kee 2009). The empirical evidence on the direction of this birth-order effect is unclear, and the effect differs by sex of the child (Härkönen 2014). Most researchers believe birth order and education have a negative relationship (Black et al. 2005). To study the extent to which age-of-arrival effects capture a “birth-order” effect, we considered the US-born children of immigrant parents, and created a birth-order dummy based on observable ages of siblings in a household. We found that older immigrant children had better education outcomes but this effect was not significant once household fixed effects are accounted for. Of course, US-born children of immigrants could have been systematically different from immigrant children, who are the focus of the present work. Given that older children usually have better outcomes and this was not the case for childhood immigrants in the sibling sample, we believe that birth-order does not drive the results. If there is indeed a birth-order effect favoring the educational attainment of older children, it is possible that age-of-arrival effects on older entrants are more negative.

Finally, sibling studies excluded only children. Even after accounting for socioeconomic conditions of parents, prior research indicated that only children complete more years of education than others and are likely to have more prestigious jobs (Falbo and Polit 1986; Falbo and Poston 1993). Quantity of siblings negatively affected educational outcomes (Bellmont and Marolla 1973) since parental resources must be spread over multiple offspring. Additionally, the presence of siblings can cause spill-over effects across children. Presence of a younger sibling with better English language skills may improve the language of the older children. Conversely, the older sibling may invest in the education of younger siblings at their own cost. If the spill-over effects are homogeneous across siblings, family fixed effects should remove them.

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5 Detailed results available upon request.
Description of the Data

Sample Selection and Variables

The effects of age of immigration on human capital were estimated off the intra-household variation in arrival ages for a sample of siblings obtained from the 2000 US Census five percent sample, specifically the Integrated Public Use Microdata Series (IPUMS) (Ruggles, et al. 2013). The 2000 US Census was a nationally representative cross-sectional dataset of the population with a large sample of childhood immigrants. It was particularly suited to the study of immigrant outcomes because of its rich information on race, ethnicity and source countries of immigrants. An attractive feature of the 2000 Census was that it reported the exact year of arrival and years of stay for immigrants. Post 2000, the Census Bureau employed the American Community Surveys (ACS) every year to ask survey questions similar to the long-form decennial Census. However, changes in the universe of the surveyed population and changes in variables and coding had occurred across the ACS years. Unlike the 2000 decennial Census 5% sample, the annual ACSes only sampled 1% of the population. For our purposes, this raised concerns about being able to compare outcomes of small select populations, like childhood immigrant siblings who arrived simultaneously. Most longitudinal datasets, if representative, did not have a large immigrant sample, especially siblings.

For immigrant children arriving to a host country under the age of 18, the migration decision is taken by their parents, though it is possible that the child’s age was factored into the household

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6 Censuses prior to 2000 and the Current Population Surveys provided multi-period intervals for the year of migration and years of stay. Precise age of arrival measures could not be constructed.

7 Basu and Insler (2017) detailed the merits of using the 2000 Census over merged ACS years in terms of larger sample size and consistent sample weighting.
migration decision. We focused on immigrant siblings who entered at ages 0-17 in the same calendar year. We observed these individuals in the year 2000. Due to collinearity, age and age-of-arrival cannot both be included in a fixed effects regression. Older people in the sample can have more education than younger people. To address these issues, we only considered individuals who are 25-55 years in 2000. Presumably, these age restrictions allow the individuals to complete their schooling. The criterion of simultaneous immigration additionally implies that age-of-arrival and years of stay in the US cannot both be included as controls. We only included childhood immigrants who have lived in the US for at least 10 years. This provides enough time to learn English and begin the naturalization process. The total number of childhood immigrants who met the sample restrictions of having entered at ages below 18, living in the US for at least 10 years and being aged 25 to 55 in 2000, was 218,619.

The US Census is a household survey. Relationships between members of a household are recorded. Siblings can be linked to each other only if they live together. It is rare for adult siblings to live together, and the sibling sample created from the 2000 US Census was smaller than the total number of childhood immigrants. It is possible that many of the childhood immigrants who are not in the sibling sample have siblings, but the Census does not link them if they set up separate households. The sibling sample consisted of 12,681 childhood immigrants. In this sample, 10,702 childhood immigrants had another childhood immigrant sibling in the household, and most of our results focused on this group. In the sibling sample, 2,311 child immigrants had a US-born sibling in the household and may also have had another childhood immigrant sibling. This subsample of the sibling sample is considered when conducting tests on the effects of birth-right citizenship. On average there were 2.15 siblings per household, and the difference in age between the oldest and

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8 These sample restrictions implied that members of the sample immigrated to the US between 1945-1990.
9 1,979 childhood immigrants only had a US-born sibling in the household, and no childhood immigrant sibling.
youngest sibling in the household was approximately 3.5 years. To reiterate, a sibling sample did not include only children, but the all childhood immigrant sample did include such individuals, although we cannot ascertain whether they were only children or had siblings who moved out of the household as they grew up.

There are many reasons for not making the sample younger, thereby reducing selection concerns about siblings who live together. Outcomes for younger children in the Census are not always available. For instance, the best outcome we could use were high-school dropout rates for 16 and 17-year-olds. This would focus the effects of age-of-arrival on the lower end of the education distribution, rather than on completed education. Unfortunately, this sample restriction also reduces variation in ages of arrival in a household. Finally, it is not common for a household to have multiple 16-17 year olds. Nevertheless, as a robustness check, we focused on this younger sample in a later section.

The 2000 Census has detailed information on spoken-English ability of all respondents, which is an important human capital variable affected by age of arrival and affecting education. The variable was self-reported, and we recognized that the measurement error in such variables can affect fixed effects estimations. The 2000 US Census also provided an individual’s highest level of education and current school attendance, which were used to create outcome variables like total years of education, high school graduation and college enrolment. The Census lacked information about school grades or scores on academic and aptitude tests. We also did not use adult outcomes like labor force outcomes, since homogenous family fixed effects were less likely to affect such decisions, vis-à-vis individual choices.

Fixed effects estimations included additional controls for sex, ethnic identity and marital status. To identify channels through which age-of-arrival affects education, English proficiency and citizenship controls were also introduced. As a basis of comparison, OLS estimates were also presented and these regressions additionally included controls for metropolitan status, birthplace and
state-of-residence.

**Differences between the All Childhood Immigrants Sample and the Sibling Sample**

Our use of the sibling sample instead of the entire childhood immigrant sample raises questions about the external validity of our estimates. It is important to identify differences between the samples. If age-of-arrival effects across siblings are homogeneous by family type, then estimates from the sibling sample can be generalized to the population. If effects of age-of-arrival are heterogeneous across siblings by parental characteristics, race and ethnicity, then the estimates are locally valid.

Fixed effects estimates of age-of-arrival effects are biased if the decision to live together affects older and younger siblings differently, and this might indeed be problematic for adult outcomes like income or employment. Fortunately, most of the language and education outcomes this work studies were formed when siblings were living together, and we can assume certain family factors were common across the children.

Table 1 shows the descriptive characteristics of people who live together and compares them to the entire random sample of childhood immigrants. *P*-value indicators are provided to note whether the two samples differ significantly in their average characteristics. The sibling sample exhibited positive selection on the basis of observables like education variables, and English ability. This may be surprising, as “less able” people might be expected to stay together. The sibling sample was on average 4.5 years younger.\(^{10}\) Siblings may be living together temporarily. For example, the incidence of divorce or separation was higher in the sibling sample (20%) than in the all childhood immigrant sample (13%). The racial composition of these households also differed. The proportion of white and Hispanic families fell and Asian households increased in Column 2. The sibling sample

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\(^{10}\)The sibling sample also had lower average years of residence in the US of about 4 years. We may be concerned that immigrants who have trouble forming attachments to the host country are living together.
members had lower wages, despite better human capital variables. There is concern that unobservable quality may be lower in the sibling sample, prompting people to live together in times of financial need.

Given the significant differences in descriptive statistics between the random sample of childhood immigrants and the sibling sample, the next step was to consider differences in correlations across variables. Table 2 presents OLS estimates of the effects of age-of-arrival on high-school graduation for all childhood immigrants and households in the sibling sample with multiple childhood immigrants. A linear trend was estimated with age 0 entrants as the base group. A linear model allows for a simpler comparison of coefficients of observable variables in the model, between the sibling sample and the full sample of childhood immigrants. The negative effects of late entry was larger in the “full sample” - each extra year of delay reduces high-school graduation probability by 2.4%. Once controls were added, the effect fell to 0.85%. The corresponding estimates of age-of-arrival effects for the sibling sample were significantly smaller. Race and ethnicity variables were insignificant in the sibling sample regression, but being male and married had negative impacts on education.

The linear effects of age-of-arrival on English proficiency and all education outcomes are presented in Table 3, for the entire sample of childhood immigrants in Column 1 and for the sibling sample in Column 2. Controls for sex, marital status and self-reported race were included. OLS estimates additionally included country of birth and state of residence controls. English and citizenship controls were included in the education regressions. Table 3 also reports fixed estimates for the sibling sample with multiple childhood immigrants in Column 3. Robust standard errors were reported in parentheses. Fixed effects standard errors were clustered by household.

Both OLS and fixed effects identified significant disadvantages of late arrival, for all samples. The OLS effects on education were less negative for the sibling sample, which was expected given
the better observables of the sample. The fixed effects were closer to OLS estimates for the entire childhood immigrants sample, which lends credence to the idea that fixed effects estimates partially mitigate the positive selection in the sibling sample. Despite the lower precision of the fixed-effects, formal $F$-tests rejected the null hypothesis of “no fixed effects” across all the outcome variables, so we preferred the fixed estimates over OLS estimates.

**Results from the Sibling Sample**

The main results of this work used the sample of siblings. A linear estimate of age-of-arrival effects cannot identify discontinuities in the age-of-arrival relationship. Additionally, household selection at younger and older ages-of-arrival can differ, indicating that the extent of the difference between OLS and fixed effects can differ by age-at-migration. Dummy variables for all ages-of-arrival were used for a more flexible estimation, and discontinuities were represented with vertical lines. The estimated OLS and fixed effect estimate for each age-of-entry and outcome variable were plotted graphically to highlight the non-linear nature of the relationship. The graphs included 95% confidence intervals for the fixed-effects estimates from the sibling sample. All fixed effects standard errors were clustered at the household level.

**Effects on English Ability**

The critical period hypothesis was developed as a way of explaining second-language acquisition. English proficiency, in itself, is known to have important repercussions in the acquisition of human capital in the US (Bleakley and Chin 2010). In this section, we attempted to identify critical ages of

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11 The differences in OLS estimates between the all childhood immigrants and sibling samples was confirmed by a test-of-difference. Results available upon request.
12 Clustering standard errors increased confidence intervals on the fixed effects estimates because we allowed for correlation between observations.
entry where English ability is affected.

“Good English” equaled 1 if the individual self-reports speaking only or very good English, and zero for other levels. Figure 1 shows that English ability and age-of-arrival had a negative and convex relation. The base group is immigrants who entered the US at age zero. OLS and fixed effects estimate different “critical ages” at which English ability of an older entrant was significantly lower than an infant immigrant. According to OLS estimates, the critical age was 4, but fixed estimates put the age at 8. The critical ages were confirmed by a joint test of significance.

OLS estimates lay outside the 95% confidence intervals of fixed estimates for older ages of entry (11-17). A child’s ability to learn a foreign language can be influenced by the home language and family’s motivation to learn English. Our results indicated that parents who migrated with younger children were differently invested in helping their children learn English. To remove homogeneous household effects, we focused on the fixed estimates.

Children entering between 8-9 have started pre-school in a foreign country, their English ability as adults was slightly worse than immigrants who enter at age 0 (5-7% gap compared to an infant immigrant). Another significant disadvantage started at age 10, when children who have completed primary school outside US were about 13% less likely to know good English. Teenage entrants were even more disadvantaged. An immigrant who was 13-14 years at entry was 20-22% less likely to speak English as well as his infant entrant sibling. Finally, the worst affected were high-school age entrants between 15-17. They were 30-34% less likely to be proficient in English.

The convexity of the relationship between age of arrival and language has been noted by other authors (Bleakley and Chin 2004, 2010; Myers et al. 2009). Bleakley and Chin (2004) note that for immigrants arriving in the US from non-English speaking countries, every delayed year after the age of 9, leads to language deterioration. The results of this work are different from those of Hakuta et al. (2003) who found a negative relationship between English language acquisition and age of arrival.
to the US; however they found no evidence of discontinuities in the relationship for adult immigrants.

**Effects on Education**

We conjectured that older entrants miss critical US-specific stimuli, which native children are exposed to, and this hampers educational attainment of immigrants. Some of these US-specific stimuli can be cultural in nature, while others are institutional.

Estimates were obtained from households with multiple childhood immigrant siblings, and the base group were infant immigrants who entered at age 0. There were 10,340 immigrants living in 4,911 households with another immigrant sibling. Education outcomes were total years of education, high school graduation and college enrolment. Controls included sex, marital status, and race. In the previous subsection, the negative and convex relation between age-of-arrival and language was established. Language and citizenship also affected education outcomes. Since we aimed to identify the channels through which age-of-arrival impacts education, the fixed effects estimates were presented with and without these mediating controls.

The relationship between education variables and age-of-arrival was also negative and convex. “Years of schooling” is the outcome variable in Figure 2. Also striking was the influence of age-of-arrival on education via the mediation of English and citizenship. Without these controls the critical age-of-arrival at which older immigrants get significantly fewer years of education than infant entrants was 8. This was also the critical age for language acquisition. Once language and citizenship controls were included, the negative impact of age-of-arrival reduced and the education gap between pre-teen and younger entrants was insignificant.

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13 Households with one immigrant sibling and only US-born siblings were excluded.
14 OLS estimates included these controls. 95% confidence intervals for FE estimates with controls were also shown.
The largest educational disadvantage compared to infant entrants is faced by teenage entrants, confirmed by a joint test of significance. On average, these immigrants get 0.5-0.85 fewer years of education. Finally, while OLS estimates are less negative, they do not lie outside the 95% confidence interval of the fixed effects estimates. The large standard errors of the fixed estimates, particularly the higher end of the age-of-arrival distribution lead to wide confidence intervals.

Age-of-arrival effects on high school graduation behaved similarly to the results for years of education (Figure 3). Without language and citizenship controls, the first trend break in age-of-arrival effects was seen at age 8. Unlike total years of education, this trend break did not disappear when controls are introduced, indicating that the effects of age-of-entry on education persisted beyond the influence on language. The magnitude of effects was much smaller, especially at older ages. The trend break at entry age 16 persisted. Entrants at the ages of 16 and 17 were least likely to be influenced by compulsory education laws; these immigrants may have arrived to the US intending to enter the labour force. They were 9% less likely to finish high-school compared to an infant immigrant.

Compulsory education laws make high-school attendance less a matter of personal choice. Both family type and personal ability affect a person’s decision to attend college. Household fixed effects cannot remove heterogeneous ability across siblings. The effects of age-of-arrival on college enrolment are shown in Figure 4. The significantly negative effect of late entry was only seen at ages of entry 16 and 17. This was true of fixed effects with or without English and citizenship controls.

The age-of-arrival estimates in this work support the findings of other authors. Bohlmark (2008) found that children arriving in Sweden at ages 9 and above have educational disadvantages compared to early-age entrants. Authors have noted that teenage immigrants in the US face large educational

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15 Recall that the sibling sample was characterized by positive selection, hence fixed effects estimates removed some of this bias. The OLS estimates from the “all childhood immigrants” sample were more significantly more negative than fixed estimates at teenage ages of entry. Results are available upon request.
disadvantages compared to pre-teen immigrants (Chiswick and DebBurman, 2004).

In order to invest in the education of disadvantaged minorities, the sources of their disadvantages must be better understood. The importance of language is underscored in our results. Furthermore, teenage immigrants also miss other non-language US-based stimuli and are more exposed to home-country stimuli. Psychologists such as Erikson (1959) and Marcia (1980) have theorized that adolescence marks the period when individuals go through the process of “identity formation.” Åslund et al. (2015) have stated that older migrants are more traditional about home-country norms, and have lower levels of social integration. Goldberg et al. (2017) found that children migrating to the US after adolescence witnessed delayed sexual onset as compared to infant entrants. Hence the act of migration can disrupt life-cycle developments for adolescents, which can in turn impact human capital formation. Given the importance of language in human capital and labour market progress, Bleakley and Chin (2004, 2010) have emphasized the need for English language programs for junior high and high-school aged entrants. Teenage immigrants can also benefit from mentorship programs and counselling in schools to aid their assimilation in a new country.

**Role of Birth-right citizenship**

US-born natives have a trivial age-of-arrival of zero. They also have the additional advantage of birth-right citizenship of the US. Immigrants can become citizens via naturalization, which can be acquired by eligible parents for their children or applied for directly after they turn 18. Federal assistance such as educational loans and scholarships are only available to citizens and legal aliens.

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16 The US education system may adapt better to younger versus older entrants. Hence education itself can affect language.

17 Anyone filing for naturalization for themselves and their family must meet certain eligibility criterion. He/she must be a legal permanent resident of the US for five years less 90 days before they apply. Rules are relaxed if they have been married to and living with a citizen for the past three years. The applicant must be “of good moral character,” and pass a test on US history and government.
The Census does not provide information on the legality of status of non-citizen immigrants. While public secondary education is available to all children, there are financial disadvantages that immigrants face, compared to natives, when deciding to attend college. Even if legal aliens have access to federal education grants, immigrant children often live in households where the family may be ineligible for, or reluctant to seek support and benefits (Hernandez 2004).

We considered a sample of households where at least one sibling is US-born and the others are child immigrants who entered the US between ages 0 to 7. In the previous subsection we saw that most human capital outcomes are adversely affected from age 8. Outcomes between young entrants and their US-born sibling should not differ by exposure to US-specific stimuli, but can differ if there are benefits from birth-right citizenship.

Table 4 shows the age of arrival effects for this subsample which also included U.S.-born siblings. Probability of citizenship was significantly lower for immigrants as expected, but their English proficiency was not different from their US-born siblings. There were no differences in years of schooling or high school graduation, since public education is available to all. Many immigrants in the subsample can be legal residents by the time of their college decisions. Others may not or live in families that are ineligible for federal assistance. Column 5 suggests that birth-right citizenship may have increased college enrolment. Liscow and Woolston (2017) studied a sample of Mexican teenage siblings, and found that legal status due to birth country affects an immigrant’s decision to stay in school. Birth-right citizenship may also explain decisions at the higher end of the education distribution.

**Heterogeneity in age-of-entry effects by origin country**

Do the education traditions of origin countries affect the age-of-arrival estimates? Exposure to home-

---

18 A joint test of significance was unable to reject the null of no difference in age-of-arrival coefficients for high school graduation and total years of education. The null was rejected at 10% significance for college enrollment.
country institutions can affect assimilation in a host country. For example, the educational attainment of children from developed countries with better education infrastructure or higher PISA scores are superior to children from developing countries, even if they arrive in the US at the same age (Heath and Kilpi-Jakonen 2012).

The country that sends the most immigrants to the US is Mexico. Educational disadvantages are particularly acute for Hispanics. Reading, science and math scores for immigrant Hispanic children in elementary school are much lower than natives, and the achievement gap between Hispanic and white students has not changed from 1990 to 2009 (National Assessment of Educational Progress 1999, 2011). Mexican households constituted 30% of the adult sibling sample, and if Mexican immigrants were over-represented in the older entrants who enter the labour market directly, the negative effects of late entry may be overstated. Mexican households are also over-represented in the unauthorized immigrant population. Removing Mexican households, we retain a subsample that was more educated - 86% have completed high-school and 66% have some college. They were more likely to be citizens, and probably hold other forms of legal residence which was not easily observable given the data.

Figure 5 shows that, when Mexican households were excluded, critical age of arrival at which English acquisition becomes difficult was 10, as opposed to 8 for the entire sibling sample. The other discontinuities in the relationship between age-of-arrival and English proficiency at age-of-arrival 13, and at 15 - were maintained. For all ages of entry, the disadvantage decreased and new estimates for ages 10 and above lay outside the 95% confidence interval of old fixed effects estimates (from Figure 1). Mexicans are more likely to intra-marry, live in enclaves and speak Spanish at home; these characteristics are correlated with lower English proficiency. Hence, the negative effects of late entry on education reduced when we exclude Mexican immigrants (Figure 6). The critical age of entry when the graduation gap between older and infant immigrants becomes significant was 14.
The significant changes in age-of-arrival effects when Mexican households were excluded is not evidence against the estimates. Akbulut-Yuksel et al. (2011) found that language proficiency disadvantages are larger for Hispanic immigrants, compared to non-Hispanic immigrants, who arrived after their critical period to the US. The effects of English proficiency on education were similar across the groups. However, the effects on enclave living and social behaviours like marriage and fertility differed, and these behaviours may have correlations with education.

Asians were also over-represented in the sibling sample. About 39% of the immigrants note that their birthplace is in Asia. Better economic and education outcomes for Asians were noted by Schoeni (1996), Leuck (2017) and other authors. Education is valued culturally, compared to other ethnic groups (Cheng and Starks 2002). However, the linguistic distance from English is high for Asian languages (Chiswick and Miller 2008). If Asian parents are motivated by better education prospects for their children while making the migration decision, they may bring children to the host country at younger ages. Indeed, the exclusion of Asians increased the magnitude of late-arrival disadvantages. The first discontinuity in English proficiency effects was seen at age-of-arrival 10 (Figure 7). Critical age-of-arrival for high-school graduation of the non-Asian sample was 8, which is similar to the results for the overall sample (Figure 8). Irrespective of origin country exclusions, we see in both figures 6 and 8, that the outcomes of teenage entrants compared with younger entrants were most negatively affected.

The trend breaks in language acquisition were similar whether Mexican or Asian households were excluded. However, the critical age at which education outcomes were adversely affected depended on the inclusion of certain groups. Critical period development affected childhood immigrants in ways over and above language development, and the origin country conditions were important.
Robustness Checks

The validity of the results from the sibling sample relies on the assumption that age-of-arrival effects are homogeneous across siblings. It is difficult to determine the extent to which parenting decisions or household conditions were homogenous across siblings. If living together affects siblings differently, fixed effects estimates are not generalizable. Certainly for labour market outcome variables, the decision would have heterogeneous effects. Since education outcomes or English ability were mainly determined at a time when the siblings still resided together as children, it is likely that “family-type” affected siblings more similarly. In the next sub-sections, we considered other samples of immigrant siblings where heterogeneity was less concerning, and compared results with our main findings.

Younger Sample

Making the sample younger by, for example, restricting it to a group most likely to live together, like children aged 0-17, is difficult since the Census does not include information on their grades. It can also be argued that younger children are still in their critical period for education. We considered siblings aged 11-17,\(^\text{19}\) who were likely to live with their parents, and analysed age-of-arrival effects on their English. As a measure of human capital, we used the high-school dropout rates of 16-17 year olds who are not bound by compulsory education laws. About 6% of all 11-17 year olds in the 2000 Census are childhood immigrants.

Of all childhood immigrants aged 11-17, 29% had another similarly aged sibling currently living with them. Over 75% of the childhood immigrants in this sample entered the US at ages under 10, so the sample is skewed towards lower ages of entry. Only 6% were teenage entrants. Given that many

\(^{19}\)The restriction that the child must live in the US for at least 10 years was not imposed. Such a restriction in the year 2000 would limit the sample to children to those who arrived at ages 0-7.
of the sample members were still learning English, for all ages-of-entry, the percentage of immigrant children who speak good English was lower than the percentage who claimed to speak good English in the adult sibling sample. Also, the English ability of young children was reported by their parents; it was not self-reported as in the case of adult respondents.

Figure 9 shows the age-of-arrival effects on English ability of young children - the relationship is negative and convex. The effects of late arrival were significantly smaller for young children than for adults. The critical age of arrival after which English ability deteriorates was now 7, with another trend break at 9. The relationship between age-of-arrival and English was still convex.

The effects of age-of-arrival on high school dropout rates of 16 and 17-year-old immigrants, who have lived in the US for at least 2 years are shown in Figure 10. Late entry still implied poorer education outcomes, or a higher probability of dropping out of school. Immigrant children from the entry age of 5 had a significantly higher probability of quitting school compared to an infant entrant. The standard errors on the age-of-arrival coefficients were large leading to large confidence intervals; there is no evidence of a trend break. This was true for fixed and OLS estimates. Cohner Goldner and Epstein (2014) found a similar relationship between age-of-arrival and dropout probabilities among Israeli immigrants. It is interesting that the OLS estimates for higher ages were smaller than the fixed estimates - family type matters when parents bring older children to the US. Older children may contribute to household finances, and join the labour force instead of going to school. The impact of age-of-arrival on completed and tertiary education, as seen in the adult sibling sample, can differ from the impact on lower levels of education like dropout probabilities. The mediation of language and citizenship was also not significant. However, we continued to see that teenage entrants had higher probabilities of dropping out of school, similar to education disadvantages seen

---

20 If childhood immigrants aged 11-17 were compared to their US-born sibling, the critical age of English acquisition was 8, as seen for the adult sibling sample.
21 Beck et al. (2012) found using an instrumental variables approach that the probability of being a high-school dropout increases significantly each year after the age of arrival of eight.
for these immigrants in the adult sample.

**Pre-migration heterogeneity across siblings**

Family fixed effects estimates can identify the true effect of age at migration on education and English ability if family effects, post-migration, are constant across siblings. However, there are sources of omitted variable bias which differ across siblings prior to immigration such as parents’ income, parents’ familiarity with US institutions, etc. Particularly worrisome is the omission of family income, which is an important determinant for children’s education (Mayer 2010).

Pre-migration conditions of immigrants cannot be recovered from the US Census. A possible solution was to use young children who are close in age to each other and hence their “early periods” overlap. For 11-17-year-old siblings, we found a negative and convex relationship between age-of-arrival and English proficiency. Next, we used a subsample of the adult sibling sample where siblings were within three years of age. The “closeness” in age reduced the differences in early childhood conditions. Unfortunately, it also reduced the variation in age-of-arrival and variability in exposure to US-specific stimuli during their critical periods.

Figure 11 shows the effects of age-of-arrival on English proficiency for this subsample in Panel A. The new FE estimates were less negative, though they lay within the 95% confidence interval of the original estimates (from Figure 1). The critical age-of-arrival for English proficiency increased to 11. Trend breaks at 13 and 15 ages of entry continued. The graph in Panel B for high-school graduation also shows that early conditions might affect the impact of late arrival, FE estimates lay outside the 95% confidence interval of the original estimates (from Figure 3). The benefits of early entry for high-school graduation were also higher. The sample restriction of siblings who were close-in-age implies that most households with more than two children were removed. Educational outcomes declined in the number of siblings (Bellmont and Marolla 1973) as parental resources must
be shared. This could be one of the reasons for better education outcomes across all ages of entry.

**Estimates for brothers-only and sisters-only samples**

Age-of-immigration profiles can differ by gender. Figure 12 compares outcomes for the brothers and sisters only samples. It is also likely that time-invariant omitted family traits or parenting techniques are more common for same-sex siblings, and a fixed-effects estimator may perform better. There were 1,963 households with a total of 4,037 only male siblings. On the other hand, restricting the sample to sisters, we had 2,295 women in 1,115 households.

The critical age at which the English ability of older entrants is significantly different from infant entrants was 8 for men, and 10 for women; however men who entered at ages 1-13 cannot be said to have had significant differences with respect to the infant. The same was true for women entrants aged 1-11. Discontinuities are shown by vertical lines, and are confirmed by $F$-tests of differences. The age-of-arrival at which high-school graduation was significantly different from infant entrants is 14 for both men and women. Despite the age at which the discontinuity is noted being the same for both genders, late arrival disadvantages were larger for women and lay outside the 95% interval of the original estimates. As discussed earlier, adolescence and “identity” formation during this period can influence the age-of-arrival effects. Girls experience puberty an average of 2 years earlier than boys. This can explain the different trend break points. On the other hand, language spill-over effects may differ across same-sex and different-sex siblings. Dahl and Moretti (2008) also noted that son preference leads to poor educational outcomes of women. If parents of daughters are less likely to integrate the age of their child into the migration decision, girls arrive at older ages. First-born daughters of traditional societies may invest more in home production, and substitute for education.

The sensitivity analyses confirmed the main results from the sibling sample. The critical age-of-
arrival for language acquisition was between 8-10 years. Language and education of teenage immigrants was most adversely affected compared to infant immigrants. Entrants who enter after compulsory education age faced additional disadvantages.

**Conclusion**

We posited heterogeneity in ages of migration as a potential explanation for the education gap between natives and immigrants. A large body of literature has considered age-of-arrival as a way to understand adult life outcomes of immigrants. However, parental selectivity was a concern if the child’s age is factored into the migration decision. We used a sample of 25 to 55-year-old siblings who entered the US together as children at different ages. Using a household fixed effects estimation method, the disadvantages of late arrival on human capital variables were assessed. We also examined the effects of birth-right citizenship on education by comparing US-born people with their immigrant siblings who arrived in the US as infants, before their “critical period.”

Our results echoed the findings of previous research. Children who entered US at ages 0 to 7 had a similar experience of “American life.” English fluency and education did not differ significantly across these immigrants. Age-of-arrival into US and outcome variables were negatively related, and this relationship was convex. The critical age after which language acquisition became difficult was 8 years. OLS estimates of English fluency were larger than fixed estimates for older ages of entry. This spoke to the need to control for household characteristics in estimating age-of-arrival effects.

We also investigated the channels through which age-of-arrival affects education. Language had a powerful effect on education outcomes, and the age of arrival at which late entrants perform worse than infant entrants was also 8. Controlling for citizenship and English delayed the adverse effects. The worst affected were teenage immigrants who acquired 0.5 to 0.85 fewer years of education than infant immigrants. Birth-right citizenship did not accord natives any additional education benefits,
except perhaps in college enrollment decisions. Different educational traditions, as determined by an immigrant’s country of origin, changed the critical ages. The exclusion of Mexican immigrants reduced the negative impact on education. The opposite was true when Asian households were excluded. The importance of early-life conditions was underscored.

Immigrants receive different benefits and disadvantages related to their age of arrival. Across disciplines, researchers have recommended investments in the environments of disadvantaged children during the early years (Phillips and Shonkoff, 2000; Knudsen et al., 2006). English language programs can be designed to help children who arrive at ages 10 and above, especially from countries where the native language is more “distant” from English. Teenage immigrants need special attention since they are past their critical period of language acquisition.

The recent flows of the US foreign-born population are mainly economic migrants from Latin America and Asia, with large linguistic and cultural gaps vis-à-vis the native population. Given the theorized channels via which age-of-entry affects education of immigrants, the outcomes of immigrant children in the U.S. could differ by country of origin. Teenage entrants living in ethnic enclaves would benefit from programs designed to help them assimilate into mainstream US society. For example, school or community-level counselling or pairing them with co-ethnic mentors may be beneficial. Girls and boys who arrive in a new host country during adolescence can benefit from peer programs in school. Of course, a feasible intervention needs a more complete cost-benefit analysis. Future research should investigate the sources of disadvantage for late arrival, whether older entrants face cognitive and cultural difficulties adapting to a new education system, or whether the education system is ill-equipped to deal with children who have matured in another environment.

**Ethical Approval Statement:** This article does not contain any studies with human participants or animals performed by any of the authors.
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Åslund, O., Bohlmark, A., & Skans, O. (2015). Childhood and family experiences and the social integration of young migrants. Labour Economics, 35(C), 135-144. doi: https://doi.org/10.1016/j.labeco.2015.05.004


Myers, D., Gao, X., & Emeka, A. (2009). The gradient of immigrant age-at-arrival effects on


### Table 1: Descriptive Statistics Comparing Different Samples.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Child Immigrants</th>
<th>Sibling Sample</th>
<th>All U.S.-born</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of Education</td>
<td>11.86 (0.011)</td>
<td>12.75 (0.044)**</td>
<td>13.48 (0.002)</td>
</tr>
<tr>
<td>% High School Grad</td>
<td>65.9 (0.0012)</td>
<td>75.9 (0.005)**</td>
<td>88.2 (0.0002)</td>
</tr>
<tr>
<td>% College Enrolled</td>
<td>44.2 (0.0012)</td>
<td>54.9 (0.006)**</td>
<td>58.1 (0.0003)</td>
</tr>
<tr>
<td>% Good English</td>
<td>65.7 (0.0012)</td>
<td>71.1 (0.006)**</td>
<td>98.8 (0.0001)</td>
</tr>
<tr>
<td><strong>Explanatory Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Male</td>
<td>52.6 (0.0011)</td>
<td>57.2 (0.005)**</td>
<td>49.8 (0.0002)</td>
</tr>
<tr>
<td>% Married</td>
<td>65.2 (0.0011)</td>
<td>23.01 (0.005)**</td>
<td>64 (0.0003)</td>
</tr>
<tr>
<td>Mean Age of Entry</td>
<td>10.4 (0.013)</td>
<td>9.6 (0.07)**</td>
<td>-</td>
</tr>
<tr>
<td>White</td>
<td>45.6 (0.0013)</td>
<td>30.3 (0.006)**</td>
<td>82.4 (0.0002)</td>
</tr>
<tr>
<td>Black</td>
<td>6.2 (0.0006)</td>
<td>7.5 (0.004)**</td>
<td>12.6 (0.0002)</td>
</tr>
<tr>
<td>Asian</td>
<td>18.7 (0.001)</td>
<td>35.2 (0.007)**</td>
<td>0.7 (0.0001)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>55.5 (0.001)</td>
<td>50.2 (0.005)**</td>
<td>5.1 (0.0001)</td>
</tr>
<tr>
<td><strong>Other Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Size</td>
<td>3.77 (0.006)</td>
<td>5.1 (0.03)**</td>
<td>2.92 (0.001)</td>
</tr>
<tr>
<td>Labour Force Participation</td>
<td>74.2 (0.001)</td>
<td>75.9 (0.005)**</td>
<td>81.1 (0.0002)</td>
</tr>
<tr>
<td>Hourly Wage</td>
<td>16.2 (0.031)</td>
<td>14.95 (0.13)**</td>
<td>16.9 (0.0031)</td>
</tr>
<tr>
<td>Age</td>
<td>36.5 (0.0202)</td>
<td>32.9 (0.08)**</td>
<td>40.2 (0.005)</td>
</tr>
</tbody>
</table>

Source: Census 2000 IPUMS sample. Sample includes individuals aged 25-55. Standard errors (in brackets) shown. “All Child Immigrant” sample includes immigrants who arrived in the U.S. at ages < 18. “Sibling Sample” includes childhood immigrants who live with another sibling – immigrant or U.S.-born. “All U.S.-Born” includes natives born in the U.S. * p < .05. ** p < .01, † p<0.1 - show if the difference in averages between the all-childhood immigrant and the sibling samples are significant.
Table 2: Cross-Sectional Linear Regression Comparing age-of-arrival Effects on High School Graduation for the “All Child Immigrant” and Sibling samples.

<table>
<thead>
<tr>
<th>Variable</th>
<th>All Child Immigrants</th>
<th>All Child Immigrants</th>
<th>Sibling Sample</th>
<th>Sibling Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of Entry</td>
<td>-0.0241**</td>
<td>-0.0085**</td>
<td>-0.0152***</td>
<td>-0.0059**</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Good English</td>
<td>-0.248**</td>
<td>-</td>
<td>0.203**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0025)</td>
<td>(0.0109)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-0.0247**</td>
<td>-</td>
<td>-0.0441**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>-0.006**</td>
<td>-</td>
<td>-0.0499**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0018)</td>
<td>(0.011)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.061**</td>
<td>-</td>
<td>-0.0298</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0048)</td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-0.043</td>
<td>-</td>
<td>0.0185</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0375)</td>
<td>(0.039)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>0.0284**</td>
<td>-</td>
<td>0.0021</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0025)</td>
<td>(0.0136)</td>
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<td></td>
</tr>
<tr>
<td>Black</td>
<td>0.0362**</td>
<td>-</td>
<td>0.0089</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0052)</td>
<td>(0.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citizenship Status</td>
<td>0.121**</td>
<td>-</td>
<td>0.136**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0022)</td>
<td>(0.0107)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy for being in sibling sample</td>
<td>0.0332**</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0043)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.0069**</td>
<td>-</td>
<td>-0.0203**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.0068)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>218619</td>
<td>218619</td>
<td>10702</td>
<td>10702</td>
</tr>
<tr>
<td>R²</td>
<td>0.0774</td>
<td>0.3428</td>
<td>0.0283</td>
<td>0.2773</td>
</tr>
</tbody>
</table>

Source: Census 2000 IPUMS sample. Robust standard errors in parentheses. Sample includes immigrants aged 25-55 who lived in the US for at least 10 years. The “All Child Immigrant” sample includes all immigrants who arrived in the U.S. at ages < 18. “Sibling Sample” includes childhood immigrants who currently live with another child immigrant. Regressions in Columns 2 and 4 include a dummy for metropolitan status, birthplace and state fixed effects. Appropriate Census weights used. * p < .05. ** p < .01, † p<0.1
Table 3: Linear Age of Arrival Effects on Outcome Variables

<table>
<thead>
<tr>
<th></th>
<th>All Child Immigrants</th>
<th>Sibling Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS Estimate</td>
<td>OLS Estimate</td>
</tr>
<tr>
<td>Good English</td>
<td>-0.0258** (0.0002)</td>
<td>-0.0333** (0.001)</td>
</tr>
<tr>
<td>Total Years of Schooling</td>
<td>-0.0761** (0.0016)</td>
<td>-0.0493** (0.008)</td>
</tr>
<tr>
<td>High School Graduation</td>
<td>-0.0085** (0.0002)</td>
<td>-0.0059** (0.001)</td>
</tr>
<tr>
<td>College Enrollment</td>
<td>-0.007** (0.0002)</td>
<td>-0.0023* (0.0011)</td>
</tr>
</tbody>
</table>

| N                        | 218619               | 10702          | 10702          |

Source: Census 2000 IPUMS sample. Robust standard errors shown in parentheses. The “All Childhood Immigrants” sample includes childhood immigrants who immigrated at ages below 18, currently are aged 25-55 years and have lived in the US for at least 10 years. The “Sibling sample” is a sample of childhood immigrants that have another childhood immigrant sibling living with them. Age of arrival is a numerical variable. OLS Regressions for all dependent variables include ethnicity, marital status, gender and metropolitan status controls, and birthplace and state-of-residence controls. For education regressions, controls for English proficiency and citizenship status are included. Estimates from “All Child Immigrant” include a binary variable for being in the sibling sample. * p < .05, **p < .01, † p<0.1.
Table 4: Effect of Birth-right Citizenship on Outcome Variables.

<table>
<thead>
<tr>
<th>Citizenship</th>
<th>English Schooling</th>
<th>Total Schooling</th>
<th>High Sch. Graduation</th>
<th>College Enroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of Entry = 0</td>
<td>-0.268**</td>
<td>0.03†</td>
<td>0.199</td>
<td>0.0072</td>
</tr>
<tr>
<td></td>
<td>(0.0256)</td>
<td>(0.017)</td>
<td>(0.166)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>Age of Entry = 1</td>
<td>-0.273**</td>
<td>0.0193</td>
<td>-0.122</td>
<td>-0.0103</td>
</tr>
<tr>
<td></td>
<td>(0.0282)</td>
<td>(0.022)</td>
<td>(0.179)</td>
<td>(0.0297)</td>
</tr>
<tr>
<td>Age of Entry = 2</td>
<td>-0.299**</td>
<td>-0.0089</td>
<td>-0.074</td>
<td>-0.0183</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.021)</td>
<td>(0.214)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>Age of Entry = 3</td>
<td>-0.283**</td>
<td>0.003</td>
<td>-0.00085</td>
<td>-0.051</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.026)</td>
<td>(0.209)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>Age of Entry = 4</td>
<td>-0.314**</td>
<td>-0.015</td>
<td>0.315</td>
<td>0.0554†</td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td>(0.028)</td>
<td>(0.275)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>Age of Entry = 5</td>
<td>-0.246**</td>
<td>-0.0438</td>
<td>-0.066</td>
<td>-0.068</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.028)</td>
<td>(0.252)</td>
<td>(0.042)</td>
</tr>
<tr>
<td>Age of Entry = 6</td>
<td>-0.387**</td>
<td>-0.017</td>
<td>-0.075</td>
<td>-0.0184</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.034)</td>
<td>(0.364)</td>
<td>(0.0454)</td>
</tr>
<tr>
<td>Age of Entry = 7</td>
<td>-0.286**</td>
<td>-0.056</td>
<td>-0.212</td>
<td>-0.0663</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.04)</td>
<td>(0.286)</td>
<td>(0.043)</td>
</tr>
</tbody>
</table>

N | 2958 | 2958 | 2958 | 2958 | 2958 |
Households | 1333 | 1333 | 1333 | 1333 | 1333 |

Source: Census 2000 IPUMS sample. Robust standard errors are shown in parentheses. Estimates use households where at least one sibling is US-born & at least one is a child immigrant who arrived to the US at age < 8. Age of arrival effects are measured using dummy variables. * p < .05. ** p < .01, † p < .1
Figure 1: Impact of age-of-arrival on the English Language Proficiency.

Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. All estimates use the Sibling sample with multiple childhood immigrants. Dependent variable is a dummy = 1 if individual speaks good English, 0 if not. FE estimates and the 95% confidence intervals are shown, and standard errors are clustered by household. OLS effects from the same sibling sample are also shown.
Figure 2: Impact of age-of-arrival on Total Years of Education

Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. All estimates use a subsample of households with multiple childhood immigrants. Dependent is total years of schooling. FE estimates with and without controls for English and citizenship are shown. 95% confidence intervals of the latter are shown. FE standard errors are clustered by household. OLS effects from the same sibling sample are also shown.
Figure 3: Impact of age-of-arrival on the Probability of High School Graduation.

Figure 4: Impact of age-of-arrival on the Probability of College Enrollment.

Source: Census 2000 IPUMS. Age-of-arrival effects estimated using dummies. All estimates use households with multiple childhood immigrants. Dependent in (3) is a binary variable for high-school graduation and in (4) for ever enrolling in college. FE estimates with and without controls for English and citizenship are shown. 95% confidence intervals of the latter are shown. FE standard errors are clustered by household. OLS effects from the same sibling sample are also shown.
Figure 5: Impact of age-of-arrival on Good English: non-Mexican sample

![Graph showing the impact of age-of-arrival on Good English proficiency for non-Mexican sample.](image)

Figure 6: Age-of-arrival effect on High School Graduation: non-Mexican sample

![Graph showing the age-of-arrival effect on High School Graduation for non-Mexican sample.](image)

Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. Fixed effects estimates are calculated for a subsample of the Sibling sample which excludes households with Mexican childhood immigrants. FE estimates from the entire Sibling sample and the 95% confidence intervals are shown for comparison. FE standard errors clustered by household.
Figure 7: Impact of age-of-arrival on Good English: non-Asian sample

Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. Fixed effects estimates are calculated for a subsample of the Sibling sample which excludes households with Asian childhood immigrants. FE estimates from the entire Sibling sample and the 95% confidence intervals are shown for comparison. FE standard errors clustered by household.

Figure 8: Impact of age-of-arrival on High School Grad: non-Asian sample
Figure 9: Age-of-arrival effects on Good English: Non-Adult Siblings aged 11-17

Figure 10: Age-of-arrival effects on High School Dropout: Siblings aged 16-17

Source: Census 2000 IPUMS. Age-of-arrival effects estimated using dummies. Fixed effects estimates in figure 5 are calculated for a sample of siblings aged 11-17, and in figure 6 for siblings aged 16-17. Original FE estimates from the Sibling sample and the 95% confidence intervals are shown for comparison in figure 5 not figure 6. FE standard errors clustered by household.
Figure 11: Impact of age-of-arrival on Outcome Variables: Closer-in-Age sample

Panel A: Impact on English Proficiency

Panel B: Impact on High School Graduation

Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. Fixed effects estimates calculated for a subsample which includes households with childhood immigrants who are within 3 years of age. FE estimates from the entire Sibling sample and the 95% confidence intervals are shown for comparison. FE standard errors clustered by household.
Figure 12: Impact of age-of-arrival on Outcome Variables: Same Sex Siblings.
Source: Census 2000 IPUMS sample. Age-of-arrival effects estimated using dummies. Fixed effects are calculated for a subsample which includes households with only sisters and only brothers in panels A and B respectively. FE standard errors clustered by household.