Immigrants, Language Barrier, and Assimilation

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Abstract

How does the language barrier affect the assimilation process of immigrants? This paper proposes a model of location choice, time allocation, and learning-from-others to study the three dimensions of immigrant assimilation: economic, linguistic, and spatial. The model shows that the characteristics that govern the newcomers’ experience of communication friction and their ability to overcome the language barrier are also determinants of their location choices at arrival – into or away from their ethnic enclave. Subsequently, the composition and quality of agents in the newcomers’ residential area influence their incentive to acquire the native language as well as determine their post-migration productivity growth, in the short- and long-run. The model generates a set of predictions about the variation in newcomers’ assimilation process that conforms to immigrant assimilation patterns in the US. For US immigrants who migrated from the 1970s to the 1990s, the fraction of a newcomer’s residential population are immigrants of the same ethnicity declines monotonically with both his English proficiency and educational attainment. Furthermore, an increase of one level of English proficiency at arrival (on a scale from 0 - cannot speak English to 3 - speak English very well or speak English only) is associated with a real wage gain of more than 7 percent ten years after. This number is even higher among newcomers who either reside away from the ethnic enclave or are from non-English-speaking countries where the English language is not frequently used.

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1 Introduction

After the end of the National Origins Formula\(^1\) in 1965, the size and composition of immigrant inflow has changed significantly. Since then, the foreign-born population has grown almost five-fold and has tripled its population share. The majority of recent newcomers are from non-English speaking countries and are not proficient in English at arrival. In 2017, the foreign-born population accounted for 15 percent of the US population (44.5 million), and approximately 48 percent reported that they could not speak English very well\(^2\). Facing this language barrier, newcomers make different choices – from where to live to how much time spent learning English – depending on their education and initial English proficiency. Those choices subsequently determine their post-migration human capital development.

To study the effect of the language barrier on newcomers’ assimilation process, I develop a partial equilibrium model with two components, a host economy and a small group of newcomers who migrate to this economy. In the host economy, natives and pre-existing immigrants accumulate productivity through random encounters (Lucas 2009). The learning opportunity comes less often in a cross-group meeting between a native and a pre-existing immigrant because of the language barrier between them (Le 2019). The newcomers who migrate to this economy differ by their education, initial English proficiency, and initial productivity. On arrival, they choose to reside in the ethnic enclave or away from the enclave where they encounter the pre-existing immigrants more or less frequently, maximizing their lifetime utility (Ahlfeldt et al. 2015). After settling down, they allocate their time between working and learning English (Ben-Porath 1967; Lucas and Moll 2014), and acquire productivity through random encounters the pre-existing immigrants and natives. Newcomers with higher education can learn faster, and those with better English have better odds at learning from natives.

The model shows that newcomers with lower education and/or English proficiency at arrival are more likely to locate in an ethnic enclave, where they have a higher present value of earnings. From their perspective, the ex-ante value of random encounters with natives is less valuable at arrival and in the near future than that with the pre-existing immigrants of the same ethnicity, even when the pre-existing immigrants are less productive than their native counterparts. Furthermore, the lower the newcomers’ education and/or English proficiency, the lower the ex-ante value of their interactions with natives is. This is one factor that leads to the monotonic relationship between the newcomers’ incentive to reside in the enclave and both their education and English proficiency.

Among newcomers with the same education and English proficiency, enclave residents encounter natives less often, and hence, they spend less time learning English, and more time working. In the short-run, these newcomers experience less communication friction and more productivity growth. In the long-run, however, they are less fluent in English and

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\(^1\) A quota on immigrant inflow based on their country of origin enacted between 1921 to 1965.

less productive because their learning source in the enclave, the mixture of more frequent encounters with the pre-existing immigrants and less frequent encounters with natives, is less productive than that of those residing away from the enclave. Therefore, their earnings are higher in the short-run, but lower in the long-run.

All else being equal, newcomers with higher English proficiency at arrival and/or pick up English more quickly experience less communication friction and more productivity growth. These immigrants experience less communication friction in random encounters with natives and therefore have more chances to improve their productivity through imitation. This prediction conforms to the immigrant assimilation patterns in the US.

The size of the pre-existing immigrant population has heterogeneous effects, in sign and magnitude, on newcomers’ productivity growth and welfare. When the pre-existing immigrants are less productive than their native counterparts, the effects are more likely to be favorable to newcomers with lower education and/or English proficiency compared to those with higher education and/or English proficiency. From the perspective of the less able newcomers, the pre-existing immigrants are more useful sources of learning when they arrive, and that remains so for a long duration of time afterward. When the pre-existing immigrant population is larger, they encounter the pre-existing immigrants more frequently, can acquire productivity more quickly, and hence, have higher welfare. For newcomers with higher education and/or English proficiency, the language barrier is a small obstacle which they quickly overcome as they become fluent in English. Subsequently, they benefit from more frequent interactions with the more-productive natives. The growing pre-existing immigrant population that crowds out the interactions with natives hence harms their productivity growth and welfare. The bigger pre-existing immigrant population lowers the incentive of all newcomers to learn English, regardless of their characteristics.

Taking the model to the data, at each cross section of the US census 1980-2010, I show the fraction of the population in an immigrant’s residential area are of the same ethnicity declines monotonically with his education and English proficiency. This observation holds when restricting sample to those recently migrated within five years before the survey. In the reduced-form analysis with a pseudo-panel created by grouping immigrants by their characteristics, I find that an increase of one level of initial English proficiency at arrival is associated with a real wage gain of more than 7 percent ten years after arrival. For immigrant cohorts who reside in regions with fewer immigrants of the same ethnicity, this number is 11 percent. I also find a negative and statistically significant association between the newcomers’ English proficiency improvement and the fraction of same ethnic immigrants. As expected from the model’s prediction, after controlling for the newcomers’ improved English proficiency, there is no statistically significant association between the newcomers’ wage growth and the fraction of immigrants of the same ethnicity due to the heterogeneity of the impacts.

Finally, I identify potential biases and challenges in estimating the elasticity of the wage rate and wage growth with respect to education and English proficiency. Due to the correla-
tion between education/English proficiency and productivity, a regression of wage and wage growth on education/English proficiency is subject to omitted variable bias when the initial productivity of the immigrants is not completely controlled for. Furthermore, instrumental variables that are used to identify the causal effect of English proficiency on earnings in the immigration literature (Bleakley and Chin 2004; Dustmann and Van Soest 2002) might not be valid and might be upwardly biased due to their correlation with immigrants’ productivity.

Related literature and contributions The first result conforms to the empirical findings of LaLonde and Topel 1997; Borjas 1998; Bauer, Epstein, and Gang 2005; Damm 2009; Bleakley and Chin 2010 who show that less-skilled immigrants have a higher tendency to live in an ethnic enclave. My paper provides an economic rationale and extends the literature’s findings in the sense that it shows and explains the monotonic relation between the tendency of an immigrant to reside in an enclave and his education and English proficiency.

This paper offers a different perspective on immigrants’ location choices that is in contrast to Borjas 1998. I show that the less able newcomers sort toward the enclave and the ethnic enclave is a transitional point at which newcomers can seamlessly assimilate to the host economy. Similarly, this paper contrasts the idea that the ethnic enclaves are a potential source of a “language trap” as they attract poor proficiency English speakers and sustain their poor abilities (Bauer, Epstein, and Gang 2005). This paper shows that less able newcomers make a willing choice of where to live, and if it is an ethnic enclave, then that is where they have the highest lifetime utility, fully knowing they would put less effort into learning English there.

Furthermore, this paper shows the importance of immigrants’ English skills as a "gateway" human capital to acquiring more human capital. It complements the literature’s view on English proficiency as an input of production (Chiswick and Miller 1992; Lazear 1999; Dustmann and Van Soest 2002; Bleakley and Chin 2004).

Finally, the analogous results of Le 2019 and this paper provide the theoretical basis to the empirical findings in the immigration literature such as (i) The immigrant-native wage gap reduces over the duration of the stay, but a permanent gap nonetheless persists for some groups of immigrants (LaLonde and Topel 1992; Schoeni et al. 1996; LaLonde and Topel 1997), (ii) The rate of wage growth for immigrants is positively correlated with the initial wage gap between them and their counterpart natives (LaLonde and Topel 1992; LaLonde and Topel 1997). This paper also offers an economic rationale for the geographical segregation that differs from earlier theories (Schelling 1971; Borjas 1998).

Paper outline Forward, I describe the model and discuss the theoretical results in section 2. Section 3 documents the variation in immigrant assimilation and the determinants of the assimilation process under the guidance of the proposed theory. Section 4 concludes.
2 The Model

In this section, I set out a partial equilibrium framework that builds on my earlier theoretical work (Le 2019) to study the newcomers’ location choice, their incentive to learn English, and their subsequent wage growth. I briefly discuss the relevant materials below but show the detailed equivalence to Le 2019 in appendix A of the online appendix.

Setup

The host economy Consider the host economy with heterogeneous agents identified by their type and productivity $(i, z) \in \{a, b\} \times \mathbb{R}^+$. Type $a$ agents are natives and type $b$ are pre-existing immigrants with the population of $\pi^a$ and $\pi^b$ respectively. In this economy, the pre-existing immigrants are the minority group, $\pi^b < \pi^a$. Each agent randomly meets others according to a continuous arrival process at rate $\alpha$, and upon a meeting, he has an opportunity to imitate the other’s productivity.

The likelihood that a native and an immigrant can imitate the other’s productivity upon a random meeting is less one due to the language barrier between them. The inverse of this likelihood is defined as communication friction.

The host economy’s productivity distribution of type $a$ evolves according to the following forward equation

$$\frac{\partial}{\partial t} \log F(z, a, t) = -\alpha \pi^a \{\log \pi^a - \log F(z, a, t)\} - \alpha \pi^b p \{\log \pi^b - \log F(z, b, t)\}$$

that is the change in the scaled productivity distribution is equal to the outflows of agents upon successful meetings with more productive agents. The analogous forward equation can be derived for type $b$.

The host economy is assumed to be on a balanced growth path (BGP). That is on the log scale, the productivity distributions of natives and pre-existing immigrants constantly shift to the right at a constant rate of $\gamma$ while retaining their shape. As shown in Le 2019, the BGP productivity distributions of type $a$ and $b$ are Frechet distributions with scale parameters $k^a, k^b$ and shape parameter $\theta$. For type $i \in \{a, b\}$, the productivity CDF at time $t$ is given by

$$F(z, i, t) = \pi^i \exp \left[ -k^i e^{\theta t} z^{-\frac{1}{\theta}} \right]$$

and the detrended CDF is $\Phi^i(x) = \pi^i \exp \left[ -k^i x^{-\frac{1}{\theta}} \right]$ where $x = ze^{-\gamma t}$ is the detrended productivity. The link between the two CDFs is that for all time $t$, the fraction of type $i$ agents with productivity $z' < z$ at time $t$, $F(z, i, t)$, is equal to the fraction of type $i$ agents with productivity $x' < x = ze^{-\gamma t}$ at time 0, $\Phi^i(x)$. Along the BGP, the pre-existing immigrants are less productive than their native counterparts, $k^b < k^a$, because the communication friction has asymmetric effects on pre-existing immigrants and natives, stronger on the former whose population size is smaller.

Natives and pre-existing immigrants reside at two locations that are denoted by \( \{a, b\} \).

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Note: The formula in the text is incomplete. The correct version should be:

$$\frac{\partial}{\partial t} \log F(z, a, t) = -\alpha \pi^a \{\log \pi^a - \log F(z, a, t)\} - \alpha \pi^b p \{\log \pi^b - \log F(z, b, t)\}$$
Here, location $b$ represents the ethnic enclave where agents of type $b$ live and location $a$ represents “away from the enclave” where agents of type $a$ live. So $\{a,b\}$ index both locations and agent types. Agents in each location interact with each other more often. Let $q_{ij}^r$ denote the fraction of time an agent in location $r$ randomly encounters an agent of type $j$, then $q_{a}^a > \pi^a > q_{b}^a$ and $q_{b}^b > \pi^b > q_{a}^b$.

The newcomers A small group of newcomers, type $b$, migrate to this economy. Newcomers differ by their initial productivity $z$, English proficiency $E$, educational attainment $e$, and permanent taste for location $\{Z_r\}$. On arrival, they have a one time choice of where to live $r \in \{a,b\}$. Once settled down, they allocate their unit of time between working and learning English to ascend the English proficiency ladder. Newcomers randomly encounter agents from location $r \in \{a,b\}$ and have the opportunity to imitate their productivity if they wish to do so.

Here, $z, e$ and $E$ are state variables. Productivity $z$ is a continuous variable that changes when an agent imitates another agent’s productivity. Education $e$ is a time invariant discrete variable. English proficiency $E$ is a discrete variable that changes when an agent improves his English proficiency. To match the US data, I assume there are five levels of educational attainment $e \in \{1– not graduated high school, 2– graduated high school, 3– some college, 4– graduated college, 5– master’s degree and above\}$ and four levels of English proficiency $E \in \{0– cannot speak English at all, 1– speaks English but not well, 2– speaks English well, 3– speaks English only or speaks English very well\}$. To avoid complication, I discuss the taste for location $\{Z\}$ in the location choice problem later.

A newcomer with better English is more likely to be able to understand and imitate a native’s productivity upon a meeting with him. Let $p(E)$ denote the probability that an immigrant with English proficiency $E$ can successfully imitate a native’s productivity in a random encounter. $p(E)$ then is an increasing function with respect to $E$. A newcomer with better English also commands a higher wage rate that is denoted by $w(z;E,r)$. For simplicity, the wage rate is given by $w(z;E,r) = z\chi(E,r)$ and is proportional to individual productivity $z$ and a (down) scaling factor $\chi(E,r)$. Here, $\chi(E,r) \leq 1$ is a measure of how effectively an immigrant can utilize his productivity $z$ given his English proficiency $E$ at location $r$.

Once settled down at location $r$, a newcomer allocates his unit of time between working and learning English (Ben-Porath 1967; Lucas and Moll 2014). Let $s$ denote the fraction of time that he spends on learning English. Then according to an exponential process of rate $\eta(s;e)$ as a function of individual effort $s$ and education $e$, he will jump up the English proficiency ladder from $E$ to $E+1$. The jump rate $\eta(s;e)$ is increasing with education $e$ and individual effort $s$, and has the diminishing return to scale property with respect to individual effort. For simplicity, $\eta(s;e) = N(e) s^\sigma$ with $\sigma < 1$ while $N(e)$ is an increasing function with respect to $e$.

\[4\]The wage rate is independent of education. I assume that all the productivity that immigrants acquire through their education is absorbed into $z$ and $E$. 


In this model, the state variable $e$ represents the methodological human capital that newcomers accumulate through their education. A newcomer with higher education has gone through rigorous training and therefore, has better fundamental skills that allow him to learn faster. Therefore, individual effort $s$ fixed, a newcomer with higher education can acquire English more quickly so $N(e)$ increases with respect to education $e$. A newcomer with higher education also has more opportunities to meet other agents. The random encounter rate for a newcomer with education $e$ is given by $\alpha A(e)$ where $\alpha$ is governed by the characteristics of the host economy while $A(e)$ is an increasing function with respect to education $e$.

### Time allocation problem

Conditional on locating in $r$, an immigrant with educational attainment $e$ and English proficiency $E$ takes the evolution of the productivity distributions as given. Then, he chooses the optimal time to learn English $s(\tau)$ to maximize his expected present value earnings with discounted rate $\rho$:

$$V^E(z,t;e,r) = \max_{s(\tau)} \left\{ \int_t^\infty e^{-\rho(\tau-t)} \left[ 1 - s(z(\tau),\tau) \right] w(z(\tau);E(\tau),r) d\tau \mid z(t) = z \right\}.$$  

Since education level $e$ and location choice $r$ are invariant with time, I suppress the indices $r,e$ in the value function leaving $V^E(z,t)$. For an incoming immigrant who cannot speak English very well, $E < 3$, his Bellman equation is

$$\rho V^E(z,t) = \max_s z \chi(E,r)(1-s)$$

$$+ \alpha A(e) q^a p(E) \int_z^\infty [V^E(z',t) - V^E(z,t)] D_{z'} \log \frac{F(z',a,t)}{\pi^a}$$

$$+ \alpha A(e) q^b \int_z^\infty [V^E(z',t) - V^E(z,t)] D_{z'} \log \frac{F^b(z',t)}{\pi^b}$$

$$+ \eta(s;e) \left[ V^{E+1}(z,t) - V^E(z,t) \right]$$

$$+ D_t V^E(z,t).$$

where the components are the earnings flow from working, the benefit flow of random meetings with natives and pre-existing immigrants, the benefit flow from jumping the English proficiency ladder, and the change with respect to time of his present value of earnings.

To solve this system of the Bellman equations, I first use a change of state variable of $x = z e^{-\gamma t}$ where $\gamma$ is the growth rate of the productivity distributions, to make them time-invariant and hence, detrended the system of Bellman equations. Since the productivity dis-

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5Newcomers with higher education $e$ work in human capital intensive occupations and have more opportunities to learn. Later, I show that this assumption is equivalent to that where newcomers with higher education learn from more capable workers that is a segregated learning environment differs depending on the individual’s education $e$. 

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tributions of natives and pre-existing immigrants are Frechet with the same tail shape $\theta$, the Bellman equation is further simplified to

$$\rho V^E(x) = \max_s x \chi(E, r) (1 - s) + \alpha \int_x^{\infty} \left[ V^E(x') - V^E(x) \right] D_x \log \Phi(x')$$

$$+ \eta(s; e) \left[ V^{E+1}(x) - V^E(x) \right] - D_x V^E(x) x \gamma + V^E(x) \gamma.$$ 

where $x$ is the detrended productivity, and $\Phi(x') = \exp \left[-k(E, e; r) x^{-\frac{1}{\theta}} \right]$ is the effective productivity distribution with an effective scale parameter

$$k(E, e; r) = A(e) \left[q^a p(E) k^a + q^b k^b\right].$$

**Proposition 1** The model is isomorphic to one in which newcomers learn at the same rate but have different learning sources. Those with higher education and/or English proficiency learn from more productive agents.

**Proof** The Bellman equation (2) is equivalent to (3) for all newcomers, and $k(E, e; r)$ is an increasing function with respect to education $e$ and English proficiency $E$. QED.

All else being equal, a newcomer with higher education $e$ and/or English proficiency $E$ also acquires productivity more quickly since he has more opportunities to learn. One way to look at it is that he is more likely to be able to acquire a native’s productivity now and in the future because he has more successful random encounters: higher $A(e)$ and $N(e)$. Proposition 1 implies that it can also be interpreted as he has more opportunities to learn because the effective probability that he encounters a more productive agent, $1 - \Phi(x)$, is higher because the effective scale parameter $k(E, e; r)$ increases with respect to education $e$ and English proficiency $E$. On the other hand, as in Le 2019, the rate of productivity acquisition declines with the newcomers’ initial productivity $x$ since he is less likely to encounter agents who are more productive than him, $1 - \Phi(x)$ decreases with respect to $x$.

I solve the Bellman equation (3) with the finite difference method described in Lucas and Moll 2014 with the appropriate boundary conditions. The boundary conditions, their reasoning, and the computation method are presented in appendix B of the online appendix.

**Incentive to learn English**

The optimal time that an immigrant spends acquiring English $s^*$ satisfies the first-order condition (FOC)

$$x \chi(E, r) = \frac{d}{ds} \eta(s^*; e) \times \left[ V^{E+1}(x) - V^E(x) \right]$$

where the left-hand side (LHS) is the marginal cost of time a newcomer spends learning English and the right-hand side (RHS) is the marginal benefit of learning English. In this model, the benefit of learning English comes from the gain in the wage rate and the gain from being
more likely to be able to learn from natives upon random encounters. The gain in the wage rate comes from the increase in the effectiveness of a newcomer in utilizing his productivity \( z \), from \( \chi (E, r) \) to \( \chi (E + 1, r) \). On the other hand, the gain in learning from natives goes through the second benefits flow in the Bellman equation (2) or the effective scale parameter (4). Both are components of the term \( V^{E+1}(x) - V^E(x) \) on the RHS.

First, newcomers’ incentive to learn English increases when the return from English skills to the wage rate is higher. The percentage return on the wage rate for an increase of one level of English proficiency is given by the ratio \( \frac{\chi(E+1,r)-\chi(E,r)}{\chi(E,r)} \). The numerator of this ratio is inside the term \( V^{E+1}(x) - V^E(x) \) of the RHS of equation (5), and the ratio shows up on the RHS when dividing both sides by \( \chi (E, r) \). When this ratio is higher, the marginal benefit of learning English is higher and the newcomer spends more time learning English.

On the other hand, \( \chi (E, r) \) can be specified as a function of education \( e \) as well such that

\[
\frac{\chi(E+1,r,e')-\chi(E,r,e')}{\chi(E,r,e')} < \frac{\chi(E+1,r,e)-\chi(E,r,e)}{\chi(E,r,e)}
\]

for \( e' < e \). Immigrants with lower education \( e \) are more likely to work in occupations that require less communication skills, for example. Therefore, those with lower education will put less effort into learning English because by the nature of their occupations, the from being fluent in English to the wage rate is not significant.

Second, the size of the pre-existing immigrant population has a negative effect on newcomers’ incentive to learn English while the aggregate productivity of natives has a positive effect. When the frequency of interactions with pre-existing immigrants \( q_b \) increases and those with natives \( q_a \) decreases, the marginal gain of being fluent in English is lower since the opportunity to use English (in random encounters with natives) comes less often. From the expression of the effective scale parameter in (4), the marginal gain in learning from being proficient in English is a function of \( q^a k^a [p(E+1)-p(E)] \) that decreases with \( q^a \). As a result, newcomers who reside in location \( b \) or migrate to a host economy with a higher fraction of pre-existing immigrants \( \pi^b \), which affects \( q^b_a \), put less effort into learning English. Since the term \( q^a k^a [p(E+1)-p(E)] \) increases with \( k^a \), newcomers have a higher incentive to learn English when natives are more productive since the ex-ante value of random encounters with natives is more valuable.

Third, newcomers with higher education \( e \) have a higher incentive to learn English and therefore, put more effort \( s^* \) into doing so. From the FOC equation (5), the marginal benefit of learning English increases with respect to education \( e \) for two reasons. First, because education and individual effort are complementary in learning English\[6\] a newcomer with higher education also has a higher marginal return for his time to learn English and therefore, spends more time doing so. Second, since the random meeting rate is increasing with respect to education, a newcomer with a higher education encounters natives more often after settling

\[\frac{\partial}{\partial e} \left( \frac{\partial \eta}{\partial s} \right) > 0 \text{ under the model’s specification.}\]
down and therefore has a higher gain from being fluent in English.

Since the model is isomorphic to a model with a segregated learning environment (proposition 1), the second reason can be interpreted as the newcomer with higher education has a higher gain from being fluent in English as he is more likely to encounter natives who are more productive than him. As a result, he puts more effort into learning English so that he can effectively learn from them.

Finally, newcomers with higher initial productivity $x$ have a lower incentive to learn English. For them, the value of learning from natives is lower, and therefore, the marginal benefit of learning English converges to the marginal gain in their wage rate. On the other hand, the marginal cost of learning English is higher since their wage rate is higher. As a result, they put less effort into doing so compared to those with lower initial productivity.

**Location choice problem**

To generalize the newcomers’ location choice problem, I use the standard recipe in the spatial economic literature. Similar to Ahlfeldt et al. 2015, a newcomer’s utility flow of settling in location $r$ is a product of his permanent taste for location $Z_r$ and his earnings flow $w(z;r)\ (1 - s^*)$. The permanent taste for location captures other unobserved factors that drive newcomers’ location choice behavior. His location choice problem is to choose location $r$ where he would have the highest ex-ante value of lifetime utility, which is given by $Z_r V_E(x)$ since $Z_r$ is a constant and can be pulled outside of the Bellman equation in (3). The taste for location $\{Z_r\}$ are drawn from independent Frechet distributions with the same tail shape $\varepsilon$ but different scale parameters $G_r, Z_r \sim \exp \left\{-G_r Z_r^{-\frac{1}{\varepsilon}}\right\}$. The fraction of newcomers that reside in location $r$ is then given by

$$\Pi_r (x, E, e) = \frac{G_r V_E(x; e, r)\frac{1}{\varepsilon}}{G_a V_E(x; e, a)\frac{1}{\varepsilon} + G_b V_E(x; e, b)\frac{1}{\varepsilon}}$$

where $V_E(x; e, r)$ is the ex-ante present value of earnings of a newcomer with productivity $x$, education $e$, and English proficiency $E$ at location $r$.

The fraction of newcomers residing away from the ethnic enclave is higher when the ratio between the ex-ante present value of earnings $\frac{V_E(x; e, a)}{V_E(x; e, b)}$ is higher. In the extreme case when there is no dispersion in taste preference ($\varepsilon$ goes to zero), the location choice of newcomers is completely determined by the ex-ante present value of earnings,

$$r = \arg \max_{r \in \{a, b\}} \left\{V_E(x; e, a), V_E(x; e, b)\right\}.$$  

On the other hand, when the tail is very thick ($\varepsilon$ goes to infinity), the location choices of

\footnote{Follows the derivation of Eaton and Kortum 2002; Ahlfeldt, Redding, Sturm, and Wolf 2015.}
newcomers are entirely driven by the taste preference with  \( \pi_r = G_r / (G_a + G_b) \).

In order to analyze the location choice of incoming immigrants, we need to know how the ex-ante present value of earnings changes with respect to newcomers’ characteristics. Since there is no closed-form solution to the Bellman equations system, the (only) viable option is to run a numerical example and deduce economic reasons from the results.

Consider a numerical example with the following specifications. Regarding the random encounter rate and jump rate across the English proficiency ladder \( \alpha \), \( A(e) \), and \( N(e) \), assume that \( A(e), N(e) \) are concave, increasing functions with respect to education \( e \). \( \sigma < 1 \) so that the jump rate is concave in individual effort \( s \). The probability of a successful meeting in a random encounter with a native, \( p(E) \), is a concave, increasing function with respect to English proficiency \( E \). I set \( \chi(E) \) so that wage rate is an increasing function with respect to newcomers’ English proficiency but are the same across locations. Regarding the location taste preference, I set \( G_a = G_b = 1 \) so that on average, newcomers do not prefer one over the other. In the host economy, I set \( k^b < k^a \) so that the pre-existing immigrants are less productive than their counterpart natives. The frequency of interactions with pre-existing immigrants in the ethnic enclave is \( q^b \) is higher than that in location \( a \) is \( q^b \).

In figure 1, I plot the fraction of newcomers who reside in the ethnic enclave. I hold education fixed in each LHS panel and English proficiency fixed in each RHS panel. First, we can see the fraction of newcomers who reside in the ethnic enclave converges to 0.5 as newcomers’ productivity increases, regardless of their education or English proficiency. This is because for very productive immigrants, the present value of learning from others is very small compared to the present value of working. Hence, the major component that drives their location choices is the present value of the earnings from working, which are identical across locations. And as a result, the fractions of newcomers located in \( a \) and \( b \) converge to 0.5 as their productivity increases. Furthermore, for newcomers with characteristics \( (x, E, e) \), if this fraction is higher than 0.5, they have a higher present value of earnings when residing in the enclave since the utility from location taste for locations \( a \) and \( b \) are, on average, the same. If it is lower than 0.5, then it is the opposite.

Regardless of their initial productivity, newcomers with higher education and/or English proficiency at arrival are more likely to reside away from the enclave, \( \pi_a(x, E + 1, e) > \pi_a(x, E, e) \) and \( \pi_a(x, E, e + 1) > \pi_a(x, E, e) \). In figure 2, I plot the fraction of newcomers who reside in the ethnic enclave as a function of education and English proficiency while holding their initial productivity fixed. The component of the present value of earnings that drives newcomers’ location choices is the difference in the value of learning from others now and in the future in each location. For newcomers who are not proficient in English and/or are unable to pick up English quickly due to their lack of education, they find it optimal to locate in the ethnic enclave to learn from pre-existing immigrants. This is because the present value of their interactions with natives is actually smaller than that with the pre-existing immi-

\[8\] The specific numbers in this example are not important for the qualitative analysis. In the next section, I calibrate the model with US census data and discuss the results then.
grants (despite the fact that natives are more productive than pre-existing immigrants) after accounting for communication friction, the ability to learn, and the potential loss of time in learning English. The opposite is true for immigrants with higher education and/or English proficiency.

From the location choices of newcomers (data and above results), by revealed preference, the pre-existing immigrant population has heterogeneous effects on newcomers’ welfare, depending on their education and initial English proficiency. In this model, the pre-existing immigrant population’s effect on the newcomers’ welfare is through its effect on the newcomers’ productivity growth. The effect on productivity growth can be observed through the effective scale parameter in (4), the change in the effective scale parameter with respect to an increase of the frequency of interactions with pre-existing immigrants is:

\[
\frac{\partial}{\partial q_{br}} k(E, e; r) = A(e) \left[ k^{b} - p(E) k^{a} \right].
\]

This quantity is the marginal effect now. It can be either positive or negative that depends on how productive the pre-existing immigrants are (measured by \( k^{b} \)) compared to their native counterparts from each individual perspective (measured by \( p(E) k^{a} \)). When the pre-existing immigrants are less productive than their native counterparts, this quantity is more likely to be negative for those who are proficient in English. However, the lifetime effect is the discounted sum of all “period” effects which change over time as newcomers become more proficient in English. Among newcomers who are not English proficient at arrival, those with higher education can acquire English quickly and hence, the effects of pre-existing immigrants are mostly negative through lifetime. For those with lower education, the effects are positive for most of their lifetime. See figure 3 for the illustration.

\[\text{The rationale of the constant fraction of newcomers with } x = 0, E = 3 \text{ (top right corner of figure 2) is that the location is driven entirely by the value of learning that is roughly the same regardless of their education under the assumption of the continuous arrival process.}\]
Figure 1: Fraction of newcomers reside in the ethnic enclave

**Not high school graduated**
- Cannot speak Eng
- Speak Eng but not well
- Speak Eng very well

**Cannot speak Eng**
- Not high school graduated
- Some college
- Higher education

**Some college**
- Cannot speak Eng
- Speak Eng but not well
- Speak Eng very well

**Speak Eng but not well**
- Not high school graduated
- Some college
- Higher education

**Higher education**
- Cannot speak Eng
- Speak Eng but not well
- Speak Eng very well

**Speak Eng very well**
- Not high school graduated
- Some college
- Higher education
Figure 2: Fraction of newcomers reside in the ethnic enclave

Productivity $x \approx 0$

Productivity $x = 1$

Productivity $x = 10^3$
Third, the fraction of newcomers who reside in the ethnic enclave decreases when either the pre-existing immigrant population is less productive or the native population is more productive. That is, all the curves in figures 1 and 2 shift downward when $k^b$ decreases or $k^a$ increases. As the pre-existing immigrant population becomes less productive, the ex-ante present value of earnings for all newcomers across locations are lower because the value of learning from pre-existing immigrants is lower across locations. However, the magnitude of this decline is bigger in location $b$ since newcomers interact with pre-existing immigrants more often if they reside in the enclave. As a result, the ratio $V^E(x;e,a) / V^E(x;e,b)$ increases and the fraction of newcomers who reside away from the ethnic enclave increases.

This change can be seen directly by differentiating the effective scale parameter in (4) by $k^b$ and see that

$$\frac{\partial}{\partial k^b} k(E,e;a) = aA(e) q^b_a < aA(e) q^b_b = \frac{\partial}{\partial k^b} k(E,e;b)$$

since $q^b_a < q^b_b$. That is the change in quality of the pre-existing immigrant population has a stronger effect on the value of learning from others for those who reside in the ethnic enclave as they interact with pre-existing immigrants more often. The asymmetry of the effects then pushes newcomers toward or away from the ethnic enclave that depends on whether the quality of the pre-existing immigrant population improves or declines. The same thing happens when natives becomes more productive.
Discussion

Education, English proficiency, and the quality of the pre-existing immigrant population all play important roles in newcomers’ choices of where to live and their subsequent development of English and productivity. Holding initial productivity fixed, newcomers with higher education and/or English proficiency are more likely to locate away from the ethnic enclave. From their perspective, the language barrier is but a small obstacle compared to the potential gain in productivity that they could have from more interactions with the more productive natives. Hence, they reside away from the enclave so they can interact with natives more often. They allocate more time to learning English and consequently, they pick up English and acquire productivity more quickly. On the other hand, for newcomers with lower education and/or English proficiency, they are better off residing in the enclave, benefiting from encountering and learning from pre-existing immigrants more frequently. From their perspective, the pre-existing immigrants are productive than their native counterparts now and in the distant future. The result conforms to the location choice pattern of immigrants documented later.

Furthermore, the result shows that instrumental variables such as the interaction between having a non-English-speaking country and the age at arrival (Bleakley and Chin 2004) and the leads and lags of self-reported language proficiency (Dustmann and Van Soest 2002) might not be valid to identify the causal effect of English proficiency on earnings. As argued earlier, initial English proficiency and English proficiency at any point in time has an important role in newcomers’ productivity growth. The instrumental variable of leads and lags of self-reported language proficiency is then likely to be correlated with the unobserved component of human capital and therefore, is upwardly biased. Furthermore, the rate at which newcomers pick up English does not only affect newcomers’ choices of where to live but also, their subsequent development of human capital. Therefore, the instrumental variable of having a non-English speaking country interacts with the age-at-arrival is positively correlated with the difference in unobserved productivity of newcomers from an English speaking country and those from a non-English speaking country.

Labor supply, English proficiency, and productivity growth in the short- and long-run

The results show that the initial labor participation/supply of newcomers who reside away from the ethnic enclave is lower compared to that of enclave residents. Furthermore, the human capital augmented labor supply and earnings of newcomers who reside away from the enclave are lower in the short-run but are higher in the long-run. As shown earlier, newcomers who reside away initially put more time into learning English and less time working. Therefore, their initial labor participation/supply is lower. In the short-run, since newcomers residing away from the enclave encounter natives more frequently, they experience more

---

10Since the fraction of pre-existing immigrants in the residential area of a newcomer with productivity $x$, education $e$, and English proficiency $E$ is given by $\Pi_b (x, E, e)$ since in location $b$, 100% of the population are pre-existing immigrants. This fraction declines with respect to the newcomer’s education and English proficiency.
communication friction, and therefore, they acquire productivity more slowly and are less productive compared to enclave residents. In the long-run, as they become fluent in English and efficiently learn from natives without communication friction, they become more productive compared to enclave residents because their learning source is more productive than that of enclave residents. Consequently, their human capital augmented labor supply and earnings are higher in the long-run. To illustrate this, figure 4 shows the ratio of the expected productivity, English proficiency, labor supply, and earnings with respect to time after arrival between a newcomer who resides away from the enclave versus one of the same characteristics who reside in the enclave (in the numerical example).

Figure 4: Ratio of productivity, English, labor supply, earnings between immigrants locate away from enclave vs. in the enclave.
Altruism and the immigrant bargain

The results imply that immigrant households have a higher altruistic value toward their children are more likely to reside away from the ethnic enclave. The location decision of a household with young children can be modeled by combining the value functions of different initial productivity $x$, education $e$, English proficiency $E$, and some altruism factor $\zeta$. The fraction of households $H$ with characteristics $\{x, E, e\}$ whose children of characteristics $\{x', E', e'\}$ reside in location $r$ is then

$$\Pi^H_r = \frac{G_r V^H (r)^{\frac{1}{\epsilon}}}{G_a V^H (a)^{\frac{1}{\epsilon}} + G_b V^H (b)^{\frac{1}{\epsilon}}}$$

where $V^H (r) = V^E (x; e, r) + \zeta V^{E'} (x'; e', r)$ is the head of household’s present value of utility. When the children’s English proficiency and/or education is sufficiently high, they have a higher ex-ante present value of earnings when locating away from the enclave. Therefore, a household head who places a significant weight on his “more able” children or has a high expectation for his children is more likely to locate away from the enclave for the benefit of his children since the value of altruism $\zeta V^{E'} (x'; e', r)$ constitutes a sizable part of the household head’s utility. This example illustrates a case of the “immigrant bargain” concept: immigrants reside away from the enclave and willingly accept jobs with little prospect of advancement in exchange for a better future for their children.
3 Immigrant assimilation patterns

In this section, I document the assimilation patterns of immigrants in the US under the guidance of the model.

Data

After the end of the National Origins Formula in 1965, the composition of immigrant inflow changed significantly and the majority of more recent newcomers came from non-English speaking countries. The English-speaking-ability self assessment question was first added to the census in 1980 and hence, in this paper, I use the US census data from 1980 forward. In particular, the data are the US decennial census from 1980-2000 and the pooled 2009-2011 American Community Survey (ACS), which is labeled as the 2010 census. In each cross-section, I select a sample consisting of male immigrants aged 25-64 at the time of the survey, who worked during the survey year, and were not enrolled in school. The data set was obtained from the Integrated Public Use Microdata Series (IPUMS) website in April 2016.

Patterns of immigrant assimilation

Location choices

For each immigrant from country $k$ in the sample of 1990, I compute the fraction of the population in their PUMA (public-use micro-data area) that has the same country of origin. I estimate the following regression model

$$y_{okr} = \alpha + \text{EDU}_{okr} \times \text{ENG}_{okr} + \gamma_{okr} + \epsilon_{okr}$$

for individual $o$ from country $k$ who migrated to the US resided in location $r$ (PUMA $r$)

- $y_{okr}$ is the fraction of the PUMA $r$ population that has the same country of origin as individual $o$, that is from country $k$,

- $\text{EDU}_{okr}$ is a vector of dummy variables that indicates whether he is not graduated high school, graduated high school, some college, graduated college, master’s degree and above,
• $\text{ENG}_{okr}$ is a vector of dummy variables that indicates whether he cannot speak English at all, speaks English but not well, speaks English well, speaks English only or speaks English very well,

• $\gamma_{okr}$ is a vector of age at time of survey, age-at-arrival, country of birth, and residential state dummy variables.

The regression results are reported in table 1. In columns 1 and 2, I report the result when interacting English proficiency with each level of education, $\text{EDU}_{oki} \times \text{ENG}_{oki}$. In columns 3 and 4, I report the result when rearranging the interaction term to $\text{ENG}_{oki} \times \text{EDU}_{oki}$. In columns 2 and 4, I restrict the sample to immigrants who recently migrated, from 1985 to 1990. Essentially, the regression captures the average fraction of immigrants of the same ethnicity who reside in the same PUMA of a representative immigrant at each level of education and English proficiency.

There are five levels of educational attainment {1– not graduated high school, 2– graduated high school, 3– some college, 4– graduated college, 5– master’s degree and above} and four levels of English proficiency {0– cannot speak English at all, 1– speaks English but not well, 2– speaks English well, 3– speaks English only or speaks English very well}, resulting in 20 groups of educational attainment and English proficiency. Every four groups in columns 1 & 2 will have the same educational attainment and four different English proficiency levels, in ascending order. Every five groups in columns 3 & 4 will have the same English proficiency level but different educational attainment levels, in ascending order.

I illustrate these regression results in figures 5-A, 5-B, 5-C, and 5-D. For each ethnic group and age at arrival, after conditioning on the same education level, immigrants with better English proficiency reside in PUMA with a lower count of same-ethnic immigrants. Holding English proficiency fixed, those with higher education reside in a PUMA with fewer immigrants of the same ethnicity. By restricting the sample to immigrants who migrated no more than five years before the survey in columns 2 and 4 of table 1 (and figure 5-B and 5-D), the results show that it is not a case of reverse causality – that is immigrants reside randomly across locations and those who do not reside in an enclave attain more education and pick up English more quickly.

In appendix C of the online appendix, I show the results generally hold when I either include fixed effects of income level at each state (interacting dummies of income quintile with dummies of states) or restrict the sample to each income quintile. When using the quintile subsample, the monotonicity breaks down for some cases and the magnitude of the phenomenon is lessen, especially in the first income quintile. These observations are also consistent when using US censuses of 1980, 2000, and 2010 and when excluding Mexican immigrants.

\[13\] For 1980 census, I use CONSPUMA which is PUMA in census of 1990, 2000, and 2010.

\[14\] The Mexican immigrant population constitutes a large fraction of the total immigrant population and hence, could skew the regression results.
Figure 5–A: Location choice, all immigrants

Figure 5–B: Location choice, immigrants migrated less than 5 years earlier
Figure 5–C: Location choice, all immigrants

Figure 5–D: Location choice, immigrants migrated less than 5 years earlier
Table 1: Education, English Proficiency, and Spatial Assimilation

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* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Wage growth and English proficiency improvement

Motivation for the reduced-form specification Under the assumption of the model that wage of an individual $o$ is given by

$$ W(o) = Z(o) \Psi(E(o), r) $$

that is real wage is the product of the unobserved productivity and a function $\Psi(E(o), r)$ that measures of the effectiveness at which he can translate his unobserved productivity to realized productivity in the new environment $r$ given his English proficiency $E$. Taking log both sides of the expression and averaging across immigrants within the same cohort $q$

$$ w_q = z_q + \sum \chi(E, r) \pi_q(E) $$

where $\pi_q(E)$ is the fraction of immigrants with English proficiency $E$ in cohort $q$; $\omega, z$ denotes the mean of log $W, Z$; and $\chi$ denotes log $\Psi$.

When the probability that an immigrant in cohort $q$ can speak English very well is used as a measure of cohort $q$’s English proficiency as in Borjas 2015, then there are two levels on the English proficiency ladder $\{0, 1\}$ and the above equation can be rewritten as

$$ w_q = \bar{\chi}(E = 0, r) + z_q + \pi_q(E = 1) \times \{\chi(E = 1, r) - \chi(E = 0, r)\} $$

$$ w_q = \beta_0 + z_q + ENG_q \times \beta_1 \quad (7) $$

where $ENG_q = \pi_q(E = 1)$ is the English proficiency of cohort $q$ and $\beta_1 = \{\chi(E = 1, r) - \chi(E = 0, r)\}$ is the percentage wage incremental when the newcomers improve their English language skills. With the ordinal measure of English proficiency, the above expression holds if the percentage wage incremental is constant for each level of improvement $- \chi(E + 1, r) - \chi(E, r) = constant$.

Hence, without loss of generality, I propose an analogous empirical specification of equation (7) : the average log wage of a cohort can be expressed as a linear combination of cohort $q$’s human capital

$$ w^q = b_0 + b_1 z^q + b_2 ENG^q + b_3 EDU^q + u^q \quad (8) $$

with $z^q, ENG^q, EDU^q$ are the log unobserved productivity, English proficiency, and educational attainment at time $\tau$. $u_\tau$ is i.i.d. error term normally distributed. On the other hand, The model implies that the growth of log productivity can be expressed in a linear form

$$ z_1 - z_0 = c_0 + c_1 (Z_0 - z_0^q) + c_21 ENG_0 + c_22 (ENG_1 - ENG_0) + c_3 EDU^q + e_0 \quad (9) $$

with all the coefficients $c > 0$. That is the productivity growth increases with the initial productivity gap $Z_0 - z_0^q$ between the newcomers and everyone else – with $Z_0$ is the aggregate
level of productivity at time 0, their initial English proficiency, their English proficiency improvement, and their educational attainment.

Subtracting the two periods of equation (8) and combine with (9), I obtain the following equation

$$
\Delta w^q = b_1c_0 + b_1c_1Z_0 - b_1c_1z_0^q \\
+ b_1c_21ENG_0^q \\
+ (b_1c_22 + b_2) [ENG_1^q - ENG_0^q] \\
+ b_1c_3EDU^q \\
+ \epsilon
$$

(10)

that describes wage growth as a linear function of multiple determinants: initial productivity gap $Z_0 - z_0^q$, initial English proficiency $ENG_0^q$, English proficiency improvement $ENG_1^q - ENG_0^q$, and education $EDU^q$. The initial productivity of the newcomers $z_0^q$ is not observed in the data but can be partially proxied by the log per capita GDP of that countries. Similarly, $Z_0$ is not observed but approximately the same for newcomers arrived in the same year – a cohort fixed effects could be used to control its variation across time.

Implementation and results

Following Borjas [2015] immigrant cohorts can be tracked across censuses using their age, year of immigration, and country of origin to study their economic and linguistic assimilation. A cohort of immigrants age $i$ from country $k$ migrated to the US in year $t$ in census $\tau$ will be ten years older in the next census. This allows keeping track of cell of immigrants across panels using their ages. Hereafter, the unit of observation will be an immigrant cell age $i \in \{25-34, 35-44, 45-54\}$, from country $k$, and migrates to the US in $t \in \{1970-1974, 1975-1979, ..., 1995-1999\}$. The sample includes immigrant cohorts from 80 countries. The sample size is 1422, which is smaller than $1440 = 3 \times 6 \times 80$ since some immigrant cohorts are missing from the data.

From the logic of (10), I estimate the following regression model

$$
dWAGE^q = \phi + \phi_k lGDP^k + \phi_{E_0} ENG_0^q + \phi_{dE} dENG^q + \phi_{edu} EDU^q + \phi_{fracfrac} + \epsilon
$$

(11)

where

- $dWAGE^q$ is the change in log real weekly wage ten years after of immigrants in cell $q = (i, k, t)$ of age $i$, from country $k$, and migrated to the US in time $t$,
- $lGDP^k$ is the per capita GDP of the source country $k$,
- $ENG_0^q$ is average English proficiency at arrival, $dENG$ is English proficiency improvement ten years after arrival, $EDU$  

15Per capita GDP data are real per capita GDP at the starting year for each entry cohort. The data come from Borjas [2015] who draws from the Penn World Table (Heston, Summers, and Aten 2012).
is the average years of education of cohort \( q \), and \( \text{frac}_q \) is the fraction of working adults who live in cohort \( q \)'s state of residence with the same ethnicity as cell \( q \).

- \( \phi \) is the vector of age and cohort fixed effects.

Under the assumption that the individual errors are i.i.d. with variance \( \sigma^2 \), the real wage growth for each cell has a variance of
\[
\frac{\sigma^2}{n_0} + \frac{\sigma^2}{n_1} = \sigma^2 \frac{n_0 + n_1}{n_0 n_1}
\]
where \( n_0 \) is the cell size at the beginning of the decade and \( n_1 \) is the respective cell size ten years later. The regression needs to be weighted by \( \frac{n_0 n_1}{n_0 + n_1} \), putting more weight on large and balanced cells. The standard errors are reported in parentheses and clustered at the source country level.

The regression results are reported in table 2. In column 1 of table 2, the regression results show compared to the mean, immigrant cohorts whose English proficiency is one level higher have an average of 7.04 percent increase in wage growth after ten years. In column 2, I interact English proficiency with the indicator of the quartile that divides the observations of each survey year by their fraction of immigrants of the same ethnicity. The magnitude of the coefficient on the initial English proficiency is highest in the first quartile and smaller in other quartiles. In column 3, I include the country of origin fixed effects and the results show that within-group, initial English proficiency has a statistically significant association with the wage growth in the first quartile, but the magnitude of the association still declines with the higher order of the quartile.

One possible explanation for the statistical insignificance in column 3 is that the result is partially driven by immigrants from English speaking countries who were mostly proficient in English at arrival or had exposure to the English language early in their lives. For these newcomers, the initial English proficiency plays a smaller role in their wage growth as they pick up English quickly after arrival (Bleakley and Chin 2004). In columns 4, 5, and 6, I report the results when restricting the sample to immigrants from non-English speaking countries. Non-English speaking countries are defined by whether their average measure of English proficiency is less than 2.5 (column 4), the minimum English proficiency is less than 2 (column 5), and English is listed as an official language in their country of origin (column 6). The results show that within-group, the initial English proficiency is positively associated with the wage growth of immigrants and the association is statistically significant. The magnitude of the association is stronger for those located in regions with a fewer immigrants of the same ethnicity.

The coefficient for the log GDP is negative, which is similar to that documented by Borjas 2015. Although the coefficient on years of education is not statistically significant and even negative, its contribution to wage growth through immigrants’ improved English proficiency improvement is netted out when including the English improvement as a regressor. In the regression model, log per capita GDP is a proxy for newcomers’ initial productivity. Since immigrants’ rate of productivity growth declines with respect to their initial productivity, that

---

\(^{16}\)I use years of education instead of education level as earlier since if I also include education level as a cell’s characteristic, the cell size would be small and hence, the random sampling errors are significant.
explains why the coefficient for log per capita GDP is negative. After netting out the contribution of education to immigrants’ English improvement, the regression of wage growth on education is essentially the regression of productivity growth on education, which then suffers a downward bias. Therefore, the coefficient for years of education is downwardly biased and becomes either statistically non-significant and even negative since the log per capita GDP of country of origin cannot sufficiently control the variation in initial productivity of newcomers across different education levels.

In table 3, I report the results when estimating an analogous model to (10) with the improved English proficiency as the explanatory variables. Compared to column 1, I add the fraction of same-ethnic immigrants as a regressor in column 2 as well as country of origin fixed effects in column 3. The difference between the coefficients for years of education and initial English proficiency in column 1 and 2 is a case of omitted variable bias. Newcomers with higher education and/or English proficiency are less likely to reside in an enclave and therefore, there is a positive correlation between the fraction of immigrants of the same ethnicity and both years of education and initial English proficiency. As a result, when the fraction of immigrants of the same ethnicity is not included, the coefficients for years of education and initial English are upwardly biased. In column 3, the variable years of education has a significant association with newcomers’ improved English proficiency after controlling for the cross-group variation that muddles the result with fixed-effects. This cross-group variation includes the variation in quality of education and the age of first exposure to the English language in newcomers’ country of origin.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years of education (EDUC)</strong></td>
<td>-0.00303</td>
<td>-0.00326</td>
<td>-0.0288</td>
<td>-0.0307</td>
<td>-0.0296</td>
<td>-0.0307</td>
</tr>
<tr>
<td></td>
<td>(0.00550)</td>
<td>(0.00536)</td>
<td>(0.0129)</td>
<td>(0.0146)</td>
<td>(0.0145)</td>
<td>(0.0133)</td>
</tr>
<tr>
<td><strong>English Improvement (dENG)</strong></td>
<td>0.201***</td>
<td>0.200***</td>
<td>0.185**</td>
<td>0.282***</td>
<td>0.275***</td>
<td>0.223***</td>
</tr>
<tr>
<td></td>
<td>(0.0521)</td>
<td>(0.0522)</td>
<td>(0.0652)</td>
<td>(0.0705)</td>
<td>(0.0679)</td>
<td>(0.0640)</td>
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<tr>
<td><strong>Initial English proficiency (ENG0)</strong></td>
<td>0.0704**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0237)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>log per capita GDP</strong></td>
<td>-0.0280**</td>
<td>-0.0288**</td>
<td>-0.00301</td>
<td>-0.0189</td>
<td>-0.0174</td>
<td>-0.0147</td>
</tr>
<tr>
<td></td>
<td>(0.00866)</td>
<td>(0.00847)</td>
<td>(0.0507)</td>
<td>(0.0555)</td>
<td>(0.0539)</td>
<td>(0.0515)</td>
</tr>
<tr>
<td><strong>Fraction of same-ethnic (frac)</strong></td>
<td>-0.00134</td>
<td>-0.00134</td>
<td>0.0123*</td>
<td>0.0125**</td>
<td>0.0126**</td>
<td>0.0135**</td>
</tr>
<tr>
<td></td>
<td>(0.00165)</td>
<td>(0.00166)</td>
<td>(0.00478)</td>
<td>(0.00452)</td>
<td>(0.00446)</td>
<td>(0.00460)</td>
</tr>
<tr>
<td><strong>Quartile frac=1 × ENG0</strong></td>
<td>0.112***</td>
<td>0.149*</td>
<td>0.249*</td>
<td>0.242*</td>
<td>0.201*</td>
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<tr>
<td></td>
<td>(0.0317)</td>
<td>(0.0723)</td>
<td>(0.105)</td>
<td>(0.104)</td>
<td>(0.0820)</td>
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<tr>
<td><strong>Quartile frac=2 × ENG0</strong></td>
<td>0.0724**</td>
<td>0.127</td>
<td>0.240*</td>
<td>0.230*</td>
<td>0.178*</td>
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<tr>
<td></td>
<td>(0.0255)</td>
<td>(0.0708)</td>
<td>(0.0976)</td>
<td>(0.0968)</td>
<td>(0.0806)</td>
<td></td>
</tr>
<tr>
<td><strong>Quartile frac=3 × ENG0</strong></td>
<td>0.0672**</td>
<td>0.108</td>
<td>0.199*</td>
<td>0.193*</td>
<td>0.157*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0236)</td>
<td>(0.0685)</td>
<td>(0.0958)</td>
<td>(0.0945)</td>
<td>(0.0785)</td>
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<tr>
<td><strong>Quartile frac=4 × ENG0</strong></td>
<td>0.0711**</td>
<td>0.0894</td>
<td>0.169</td>
<td>0.163</td>
<td>0.139</td>
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<td></td>
<td>(0.0233)</td>
<td>(0.0687)</td>
<td>(0.0995)</td>
<td>(0.0979)</td>
<td>(0.0789)</td>
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<td><strong>Constant</strong></td>
<td>0.342***</td>
<td>0.350***</td>
<td>0.337</td>
<td>0.313</td>
<td>0.297</td>
<td>0.354</td>
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<tr>
<td></td>
<td>(0.0855)</td>
<td>(0.0836)</td>
<td>(0.462)</td>
<td>(0.538)</td>
<td>(0.524)</td>
<td>(0.485)</td>
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<tr>
<td><strong>Country of origin fixed effects</strong></td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>average ENG0&lt;2.5 (48 countries)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>min ENG0&lt;2 (51 countries)</td>
<td></td>
<td></td>
<td>YES</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENG is not official language (71)</td>
<td></td>
<td></td>
<td></td>
<td>YES</td>
<td></td>
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<tr>
<td>Observations</td>
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<td>1422</td>
<td>1422</td>
<td>823</td>
<td>876</td>
<td>1224</td>
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<tr>
<td>Adjusted $R^2$</td>
<td>0.361</td>
<td>0.363</td>
<td>0.429</td>
<td>0.447</td>
<td>0.439</td>
<td>0.435</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Real wage is log weekly earnings, adjusted for inflation and deflated by education-age deflator. English proficiency is an ordinal measure that equals to 0 if an immigrant cannot speak English at all, 1 if he speaks English but not well, 2 if he speaks English well, 3 if he speaks English only or speaks English very well; Fraction of pre-existing immigrants is percentage point.
Table 3: English proficiency improvement

<table>
<thead>
<tr>
<th></th>
<th>(1) dENG</th>
<th>(2) dENG</th>
<th>(3) dENG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of education (EDUC)</td>
<td>0.0147*</td>
<td>0.00867</td>
<td>0.0244***</td>
</tr>
<tr>
<td></td>
<td>(0.00573)</td>
<td>(0.00529)</td>
<td>(0.00458)</td>
</tr>
<tr>
<td>Initial English proficiency (ENG0)</td>
<td>-0.198***</td>
<td>-0.211***</td>
<td>-0.490***</td>
</tr>
<tr>
<td></td>
<td>(0.0240)</td>
<td>(0.0251)</td>
<td>(0.0357)</td>
</tr>
<tr>
<td>log per capita GDP</td>
<td>0.0144</td>
<td>0.0221**</td>
<td>-0.00170</td>
</tr>
<tr>
<td></td>
<td>(0.00798)</td>
<td>(0.00803)</td>
<td>(0.0179)</td>
</tr>
<tr>
<td>Fraction of same-ethnic (frac)</td>
<td>-0.0103***</td>
<td>-0.00699*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00157)</td>
<td>(0.00267)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.264***</td>
<td>0.322***</td>
<td>0.865***</td>
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<td></td>
<td>(0.0750)</td>
<td>(0.0821)</td>
<td>(0.140)</td>
</tr>
<tr>
<td>Country of origin fixed effects</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Observations</td>
<td>1422</td>
<td>1422</td>
<td>1422</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.572</td>
<td>0.597</td>
<td>0.702</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

*p < 0.05, ** p < 0.01, *** p < 0.001

English proficiency is an ordinal measure that equals to 0 if an immigrant cannot speak English at all, 1 if he speaks English but not well, 2 if he speaks English well, 3 if he speaks English only or speaks English very well; Fraction of pre-existing immigrants is percentage point.
4 Concluding remarks

This paper proposes a parsimonious knowledge diffusion model to study the assimilation of immigrants: how English skills, education, and pre-existing immigrants affect their location choices, their incentive to learn English, and their skill accumulation. English proficiency and education play an important role in the location choice of newcomers and, subsequently, their effort in learning English and their productivity growth. The quality of the pre-existing immigrant population also influences the newcomers’ location choices. More newcomers would reside in the enclave if the pre-existing immigrants, who reside in the enclave, are more productive. Furthermore, the model predicts that the pre-existing immigrant population has heterogeneous effects, in sign and magnitude, on newcomers’ productivity growth and welfare that depends on its quality and the newcomers’ education and English proficiency.

The model’s theoretical predictions are consistent with patterns of immigrant assimilation that are observed with US data. With US census data, this paper shows that within the same country of origin group, newcomers with higher education and/or English proficiency reside in regions with fewer immigrants of the same ethnicity. Furthermore, the reduced-form results show that an increase of one level of initial English proficiency is associated with a real wage gain of more than 7 percent, ten years after later. This number is higher for those residing in regions with fewer immigrants of the same ethnicity. The reduced-form regressions show no statistically significant between real wage gain and the fraction of immigrants of the same ethnicity, as predicted by the model when aggregating the heterogeneous effects together.

There are several policy implications and forward research inquiries prompted by the findings of this paper. First, as shown in this paper, location choices of newcomers partially depend on their characteristics, a shift in immigration policy that alters the composition of the immigrant inflow will have differential regional economic impacts across locations. That leads to the following line of questions: What are the potential economic impacts across regions of alternative immigration policies? Which states, cities should pay which upon a change of immigration policy? Second, initial English proficiency has important value in the economic assimilation of the newcomers and its value depends on their country of origin, education, and so on. If one wishes to design a immigration point system that maximizes the newcomers’ economic integration (and hence, minimizes their dependence on public welfare system), how to allocate points optimally across newcomers’ characteristics – such as their native language skills and education? I believe it is within the literature interest and would be beneficial to policymakers to further research along these lines of inquiry.
References


Young, Malcolm B et al. (1995). “National Evaluation of Adult Education Programs. Executive Summary.” In: