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Language Skills and Labor Market Outcomes of Immigrants in Europe

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Abstract

This paper studies the causal impact of language skills on human capital accumulation, labor market outcomes, and job characteristics of childhood immigrants across European countries. Using PIAAC data, we adopt an instrumental variable strategy based on the critical age hypothesis and linguistic distance. Our IV results show that higher language proficiency boosts human capital accumulation through formal schooling and actual labor market experience, resulting in improved labor market outcomes in terms of earnings and hours of work. Language proficiency also affects job tasks, increasing employment of reading and abstract tasks while decreasing physical work, and reduces education-job mismatch. These results indicate that language proficiency plays a significant role in enhancing productivity of immigrants in the European context.

JEL classification

F22, J15, J24, J31, J32, J61

Keywords

immigration, language proficiency, labor market, job tasks, PIAAC

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1 Introduction

Language proficiency is central to immigrant integration, shaping employment, earnings, and social mobility (Isphording and Otten, 2014). While early studies relied on observational data from single-country settings (Dustmann and van Soest, 2001; Bleakley and Chin, 2004), recent research has used experimental and quasi-experimental methods, including evaluations of language training programs, to establish causal effects (Lochmann et al., 2019; Foged and van der Werf, 2023; Schmid, 2023; Kim et al., 2025). This study broadens the scope by conducting a multi-country analysis of language proficiency's impact in European countries using PIAAC data and examining a comprehensive set of outcomes, including human capital accumulation, labor market outcomes, and job characteristics, using unique measures.

We examine how language proficiency shapes immigrant outcomes across several domains. First, we study its effects on labor market participation, hours worked, and earnings—capturing both extensive and intensive margins of labor supply. We then assess its role in human capital accumulation, not only through formal education but also via on-the-job learning, measured as the gap between potential and realized work experience. Finally, we analyze how language skills influence the types of jobs immigrants hold—focusing on occupational prestige, task content (e.g., reading, abstract reasoning, physical labor), and the alignment between education and job requirements. Together, these outcomes capture how language proficiency affects access to employment, skill development, and the effective utilization of human capital in the labor market.

Because language proficiency is likely endogenous—correlated with individual traits like motivation and subject to reverse causality—we use an instrumental variable (IV) strategy based on the interaction of age at arrival and linguistic distance (Bleakley and Chin, 2010; Isphording and Otten, 2014) and drawing on the insight of Sweetman and van Ours (2015), who highlight that the challenge of language acquisition is exacerbated when immigrants are required to learn a language that is structurally distant from their mother tongue. The approach exploits the critical period for language acquisition (Lenneberg, 1967; Newport,

2002) and the learning difficulty posed by linguistic distance.

The validity of our instrument requires that, conditional on controls, the interaction between age at arrival and linguistic distance affects the outcome only through language proficiency. This assumption holds if there are no other omitted factors correlated with the instrument that directly impact the outcome. To support our identification strategy, we include age-at-arrival groups as control variables, show that parental education does not differ significantly between early and late arrivals, and control for parental education as a robustness check.

In addition, immigrants from linguistically distant countries could differ in other unobserved dimensions—such as cultural norms or integration trajectories—that affect labor market performance. To address this, we include detailed controls and show that our results are robust to including cultural distance metrics. We also demonstrate that linguistic and cultural distance are only weakly correlated in our sample. We present estimates from both IV results, which offer plausibly causal effects, and OLS results; each approach has its own limitations, allowing for a comparison between the two methods.

Our findings do not reveal a significant effect of language skills on labor force participation or employment probability, suggesting that sample selection is not a concern for the analysis of earnings. However, we find positive and significant effects on hourly earnings and weekly hours of work, indicating that language skills enhance labor market productivity. Moreover, higher language skills reduce the gap between potential and actual labor market experience, suggesting they facilitate on-the-job human capital accumulation. We also document a strong link between language proficiency and job characteristics. We find that higher language proficiency leads to higher occupational prestige and increased engagement in reading and abstract tasks, and a reduced likelihood of performing physically demanding work.

Our results also show that language proficiency improves the education-job match, increasing the probability that immigrants work in roles aligned with their formal education while reducing overqualification and underqualification. On the human capital front, we find

positive effects on schooling. However, unlike findings in the U.S. context, we find no evidence that schooling is a significant mediator for the effect of language skills on earnings in the European context. In sum, our results provide strong evidence for the positive effects of language ability in enhancing immigrant skills and their effective utilization in the European labor market.

Our study contributes to the literature on the causal effects of language proficiency on labor market outcomes. Previous research has employed IV strategies to address endogeneity, often relying on self-reported language proficiency (Kim et al., 2025). For instance, Dustmann and Fabbri (2003) combine a matching estimator with an IV approach, to show that poor language skills lead to lower earnings and reduced employment among ethnic minority immigrants in the UK. Motivated by the critical age hypothesis from psychobiological literature, Bleakley and Chin (2004), Isphording and Sinning (2012) and Guven and Islam (2015) find positive effects of English proficiency on earnings of childhood immigrants, with schooling acting as a key mediator in the U.S. context but not in Australia.

Similarly, Yao and van Ours (2015) document negative labor market effects of Dutch language deficiency in the Netherlands, while Isphording (2013) show that foreign language proficiency in Spain generates high returns, mediated by occupational choice. We extend the findings of these earlier studies that focus on a particular host country by providing a multi-country perspective using PIAAC datasets which comprises homogeneous set of economically comparable European countries.

The relationship between human capital, job tasks, and wages has been widely studied in the literature. Autor and Handel (2013) find that job task variation is systematically related to race, gender, and language proficiency, even among workers in the same occupations. Our study contributes to the literature by studying the effect of language skills on job tasks among childhood immigrants. Earlier studies in the U.S. show that childhood immigrants from linguistically distant countries develop a comparative advantage in certain tasks (Bacolod and Rangel, 2017) and language proficiency enhances oral expression and mathematical reasoning

while reducing reliance on manual dexterity (Adserà and Bhowmick, 2022). However, these studies primarily rely on O*NET-based occupational task classifications, which assume that all workers in a given occupation perform similar tasks (Acemoglu and Autor, 2011).

Our paper advances this literature by providing the first evidence on how language proficiency affects worker-reported job tasks among immigrants. This distinction allows us to capture within-occupation variation, offering a more precise understanding of how language skills influence job task allocation. We also supplement our analysis with O*NET-based task intensities to address potential biases in self-reported job tasks. Our findings indicate that these two distinct job task estimation approaches yield consistent results. Moreover, our results align with existing evidence from the U.S. and extend these insights to Europe.

This paper also contributes to the education-job match literature by examining how language proficiency influences skill utilization in the workplace. Education-job mismatch, where workers are over- or under-qualified, reduces productivity and job satisfaction and is associated with wage penalties (McGuinness et al., 2018). While language skills facilitate schooling, they also play a crucial role in ensuring that acquired qualifications are effectively utilized in the labor market. Consistent with findings from Australia (Santiago and Carlos, 2021), we show that in Europe, higher language proficiency increases the likelihood of immigrants working in roles aligned with their formal education.

The findings of this paper have policy implications for language training programs, which have become central to immigrant integration policies. Recent research highlights the importance of program intensity and duration in achieving successful labor market integration (Lochmann et al., 2019; Foged et al., 2023, 2024; Heller and Mumma, 2023; Pont-Grau et al., 2023). Our results suggest that childhood immigrants arriving at later ages may benefit disproportionately from structured, age-specific language training interventions. These findings emphasize the need for targeted language programs tailored to different age groups to maximize their impact on immigrant integration.

The remaining of the paper is organized as follows. Section 2 presents the conceptual

framework for the importance of language ability on labor market success. Section 3 discusses the data used in our analysis and provides evidence on the critical age hypothesis from our data. Section 4 presents the empirical method. Section 5 presents the results and provides the robustness analysis of the main findings. Section 6 concludes with a discussion.

2 Conceptual Framework

Three factors determine language proficiency among international migrants: exposure, economic incentives, and efficiency (Chiswick and Miller, 2014). Exposure increases with post-migration contact and duration of residence, and enhancement in proficiency is especially pronounced in the early years (Chiswick and Miller, 2001; Espenshade and Fu, 1997). Economic incentives matter because migrants invest more in language learning when financial returns are expected (Dustmann, 1994). Efficiency captures individual and linguistic characteristics that affect ease of acquisition.

Age at migration and linguistic distance are central to efficiency. The critical age hypothesis posits that brain plasticity for language learning declines after childhood (Lenneberg, 1967). Evidence from the U.S. confirms a break-point at age 10–12 using self-reported ability (Bleakley and Chin, 2004, 2010). Other work finds even younger thresholds based on schooling outcomes (Beck et al., 2012). Sweetman and van Ours (2015) further emphasize age at arrival as a driver of both language acquisition and broader integration outcomes. Linguistic distance also affects acquisition: migrants from linguistically distant countries face more difficulty learning the host language leading to proficiency gaps (Isphording and Otten, 2011; Kim et al., 2025). These gaps contribute to long-run labor market disparities.

According to human capital theory, strong language skills boost productivity by enabling access to high-skill tasks and reducing underemployment risks (Becker, 1964). Task-based labor models argue that advanced language proficiency enables complex and communication-intensive work, while limited skills restrict workers to manual or routine jobs with lower

wages and mobility (Acemoglu and Autor, 2011; Cassidy, 2019). Language proficiency also influences how well immigrants match with jobs suited to their education. Weak skills can lead to over- or under-qualification (Leuven and Oosterbeek, 2011), and may signal lower productivity to employers despite strong credentials (Spence, 1973).

In summary, language proficiency is a pivotal factor in shaping labor market success of immigrants. By shaping job task performance, job-skill alignment, and employer perceptions, language skills influence both access to high-skill jobs and earnings potential. This study primarily focuses on efficiency in language acquisition, emphasizing the role of age at migration and linguistic distance in determining long-term language proficiency and economic integration.

3 Data

We use data from the 2011-2012 Programme for the International Assessment of Adult Competencies (PIAAC) provided by OECD. It measures literacy, numeracy, and problem-solving skills; collects labor market information including employment status, earnings, job tasks, and educational attainment, as well as demographic characteristics. The dataset also includes information on migration, such as age at immigration, country of birth, and language spoken during childhood.

Our analysis focuses on European host countries with available labor market data.[1] Due to data limitations on labor market outcome variables such as hourly wage, our primary empirical analysis is restricted to Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Norway, and the United Kingdom. This selection ensures a relatively homogeneous economic setting, facilitating a multi-country analysis.

We focus on first-generation childhood immigrants—individuals who migrated before age 19 and whose parents were both foreign-born. This group likely migrated as tied movers

[1]The initial set we use to test critical age hypothesis includes Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, and the United Kingdom.

with their families, with the critical period hypothesis playing a key role in their language acquisition. Our analysis sample includes childhood migrants aged 16 to 65 at the time of the survey who are employed or actively participating in the labor market.[2] For cross-country comparability, all monetary values (e.g., earnings) are adjusted for purchasing power parity (PPP), and we exclude a single observation, with an implausible hourly earning of $51,149, to avoid the influence of extreme values.

For language ability, we use literacy scores from the PIAAC dataset, which assess individuals' ability to understand and use written texts in daily life. The PIAAC literacy score is a continuous variable, and we standardize it within each host country so that it has a mean of 0 and a standard deviation of 1. This standardization ensures comparability across countries.

Earlier studies recognize the strong positive correlation between reading and speaking skills (Liao et al., 2010; Chiswick and Repetto, 2000; Dustmann, 1994), and thus our literacy-based measure serves as a reliable proxy for broader language skills relevant to the labor market.[3] Unlike earlier empirical studies that rely on self-reported speaking ability, which is subject to measurement error and reference-point bias, PIAAC literacy scores provide an objective, standardized, and cross-nationally comparable measure of language proficiency. This ensures consistency across host countries and mitigates concerns about subjective assessments of language skills.[4]

While the PIAAC literacy score offers an objective and standardized measure of language proficiency, it is important to acknowledge that it may capture broader cognitive skills beyond oral fluency, such as reasoning and concentration. Ideally, language ability

[2]We selected age 16 as the lower bound to remain consistent with the structure of the PIAAC dataset. Since the analysis focuses on individuals who are employed or actively participating in the labor market, our empirical sample includes only five individuals under the age of 18.

[3]It is, however, important to acknowledge that different dimensions of language ability, beyond fluency, play important roles in labor market outcomes. In particular, literacy skills may be especially important for complex tasks that involve higher-level reasoning and problem-solving, which typically offer higher returns.

[4]In our sample, only four individuals in Norway and Austria completed the background questionnaire in their mother tongue or in English. However, all participants took the PIAAC test in the official language of their respective countries.

would be measured independently of other cognitive abilities. However, alternative domains in the PIAAC survey, such as numeracy and problem-solving, also require substantial reading comprehension, rendering them endogenous to language proficiency. As documented by Hanushek et al. (2015), literacy significantly predicts performance in other cognitive assessments. Controlling for these domains would likely attenuate the estimated effect of language proficiency by conditioning on downstream outcomes.

Importantly, our identification strategy exploits exogenous variation in language acquisition driven by age at arrival and linguistic distance, two factors that affect language learning during childhood but are unlikely to generate discrete changes in general cognitive ability. Unlike language acquisition, cognitive development is generally considered to follow a continuous trajectory over childhood and adolescence, without sharp thresholds at the ages we examine. We therefore interpret the literacy score as a valid and policy-relevant proxy for applied language skills, particularly in labor market settings where comprehension and reasoning are both essential to workplace performance. This interpretation aligns with existing work that treats literacy scores as a robust proxy for language proficiency in labor market contexts, despite their partial overlap with broader cognitive skills (Daley et al., 2019; Mueller and Truong, 2022).

As part of our instrumental variable strategy, we construct the linguistic distance between the host country's language and the language spoken at home during childhood. While previous literature focuses on the dominant language of immigrants' place of origin, the PIAAC dataset has the advantage of collecting language spoken during childhood, allowing for a more precise calculation of linguistic distance. We employ the Automated Similarity Judgment Program (ASJP) dataset, developed by the German Max Planck Institute of Evolutionary Anthropology, to measure phonetic and structural dissimilarity between languages. The Levenshtein distance provides a continuous measure of linguistic differences, capturing how difficult it is to learn a host-country language given the language spoken at home during

childhood.[5] For example, the distance between English and Vietnamese is 104, whereas between German and Dutch it is 52. Figure A1 illustrates the distribution of linguistic distance and language scores within the childhood migrant sample, second-generation immigrants and natives. These distributions underscore the variation in both variables that underlies our instrumental variable strategy.

In our estimation sample of 637 employed individuals, 357 arrived at age 11 or younger, and 90 have a linguistic distance of zero. In total, 375 individuals have an instrument value equal to zero. Among the 90 observations with zero linguistic distance, approximately one-third originate from countries with colonial ties to their destination, such as Algeria, Morocco, or Senegal in the case of France, and India, Jamaica, or Nigeria for the UK.[6]

We examine various labor market outcomes, including labor force participation, employment, hours of work, and hourly earnings at the time of the survey. Figure 1 shows the kernel density plots of (log) hourly wages for childhood immigrants above and below the mean level of literacy score standardized in the entire sample within each country. Childhood immigrants above the mean score have higher hourly wages. We observe similar patterns for different labor market outcomes and job tasks (See: Figure OA1 in Online Appendix).

In addition to traditional labor market indicators, we examine occupational prestige, which reflects the public's perception of an individual's social status based on their profession. Occupational prestige scores are constructed using two-digit ISCO08 codes[7] mapped to a continuous prestige index following Ganzeboom (2010). For example, 'health professionals' have an occupational prestige score of 77, while 'personal service workers' have a score of 28.

The PIAAC Survey also includes a broad range of questions related to actual tasks performed on the job. Following the strategy of Agasisti et al. (2021), we create task intensity

[5]Since multiple languages may be spoken at home during childhood, we use the shorter linguistic distance in our instrument.

[6]The remaining zero linguistic distance observations are primarily due to migration from geographically or linguistically close countries (e.g., Germany to Austria, Netherlands to Belgium, Ireland to the UK), or may reflect bilingual households.

[7]We utilize two-digit level codes since four-digit level codes are not available for every country in the sample for main analysis.

Figure 1: Kernel Density Plots of Log Hourly Wages

Note: Kernel density plots refer to childhood immigrants above and below the mean level of standardized literacy score. The sample consists of first-generation childhood immigrants arrived in the host country by age 19 with both parents born outside of the host country and currently aged 16 to 65 with non-missing wage, literacy score, age at arrival, years of schooling, region of birth and linguistic distance variables.

indices using principal component analysis (PCA) for writing, reading, influencing others, abstract tasks, and physical work. For robustness checks, we also use task intensity indices derived from the O*NET database, which provides detailed information on a wide range of characteristics required to perform specific jobs.[8]

As a measure of human capital accumulation at work, we examine the "experience gap", defined as the difference between potential and actual years of experience. Potential experience is calculated as the difference between an individual's age and the age at which they left formal education, while actual experience is measured by the total years of work experience recorded in the data. A larger experience gap suggests delays in labor market entry or periods of unemployment.

To explore the relationship between language ability and education-occupation mismatch, following Santiago and Carlos (2021), we define the required schooling for an occupation as the one-standard-deviation range around the mean level of schooling.[9] An individual is classified as overqualified if their education exceeds this range and underqualified if it falls below.

Using the PIAAC data sample, Table OA1 in online Appendix presents the proportion

[8]In notes of Table OA11 in Appendix, we share the grouping of variables to create the task intensity indices.

[9]As mean value may be sensitive to outliers, we also use the range around the median and modal values to do robustness analysis.

of immigrants residing in each country and the distribution of these immigrants by birth region. The table reveals significant cross-country differences in the demographic composition of the immigrant population by birth region, providing substantial variation in linguistic distance. The composition of immigrants in our sample varies notably across host countries and broadly aligns with the demographic structure of immigrant populations in these countries. For example, the relatively high representation of immigrants from Central and Eastern Europe in Austria and Germany reflects historical migration trends, while the large share of immigrants from Arab States in France and the Netherlands corresponds to well-documented migration patterns. Furthermore, the overall immigrant population shares in our sample closely match official estimates, indicating that the dataset provides a reasonably representative depiction of immigrant demographics in these countries.

Table 1 summarizes key descriptive statistics for our sample of 1,436 individuals (637 employed), with outcomes for the full sample in the top and employed sample in the bottom panel. Balance tests in Table A1 show no significant differences in age, gender or parental education between those arriving before and after age 12, supporting the plausibility of exogenous age-at-arrival variation. Before moving to the empirical strategy, we provide evidence on the critical age hypothesis using our data.

Table 1: Descriptive Statistics, Mean values

Panel A: Full Sample	(1) Young Arrivers (0-11)	(2) Old Arrivers (12-18)	(3) Difference
LFP	0.717	0.683	-0.033
	(0.451)	(0.466)	(0.024)
FT Employment	0.578	0.582	0.004
	(0.494)	(0.494)	(0.031)
Employment	0.731	0.758	0.027
	(0.444)	(0.429)	(0.028)
Observations	794	642	1,436
Panel B: Sample of Employed			
Log Hourly Wage	2.814	2.796	-0.018
	(0.465)	(0.470)	(0.037)
Wage Decile	5.171	4.632	-0.539**
	(2.713)	(2.638)	(0.214)
Occ Prestige	41.474	38.517	-2.956*
	(19.698)	(20.555)	(1.619)
Experience Gap	3.211	4.932	1.721***
	(4.712)	(5.969)	(0.424)
Log Hours Worked	3.554	3.520	-0.034
	(0.333)	(0.403)	(0.029)
Years of Schooling	12.062	11.700	-0.362
	(3.133)	(3.440)	(0.261)
Reading	0.110	-0.279	-0.389***
	(1.655)	(1.700)	(0.134)
Writing	0.244	-0.090	-0.333***
	(1.336)	(1.418)	(0.110)
Influence	-0.057	-0.331	-0.274**
	(1.306)	(1.364)	(0.107)
Abstract	-0.150	-0.367	-0.217**
	(1.277)	(1.368)	(0.105)
Physical Work	0.457	0.554	0.097**
	(0.499)	(0.498)	(0.040)
Overqualified	0.078	0.054	-0.025
	(0.269)	(0.226)	(0.020)
Wellqualified	0.681	0.643	-0.038
	(0.467)	(0.480)	(0.038)
Underqualified	0.241	0.304	0.063*
	(0.428)	(0.461)	(0.035)
Observations	357	280	637

Notes: Standard deviations in parentheses. The sample consists of first-generation childhood immigrants who arrived in the host country by age 18, with both parents born outside of the host country. It includes individuals aged 16 to 65 with non-missing values for wage, literacy score, age at arrival, years of schooling, region of birth, and linguistic distance.

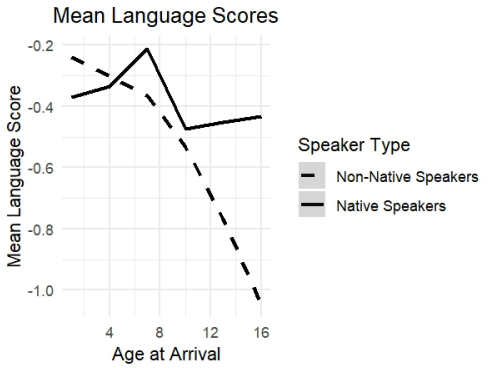
3.1 The Critical Age: Age at Arrival and Language Proficiency

Figure 2 Panel (a) depicts the mean language ability among childhood immigrants from non-native and native-speaking countries for each level of age at arrival.[10] Immigrants from

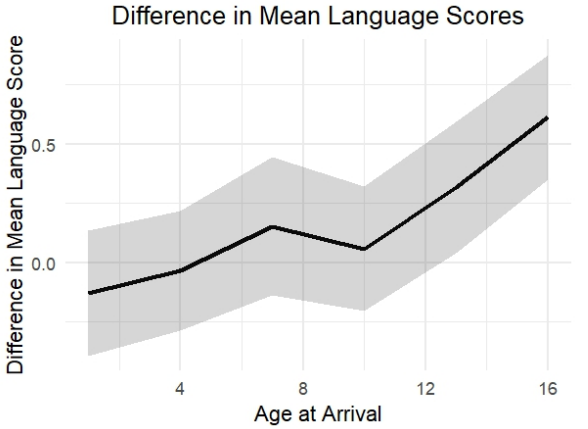
[10]It is important to note that literacy scores are standardized within each host country using all PIAAC sample including natives and immigrants.

native speaking countries have a relatively stable level of standardized literacy scores with a modest reduction after the age of seven while immigrants from non-native speaking countries who arrived at young ages acquire the same levels of literacy as their native-speaking peers.

Figure 2: Age at Arrival and Language Proficiency



(a) The Mean Standardized Literacy Score (y-axis) at each age at arrival (x-axis). The sample consists of first-generation childhood immigrants arrived in the host country by age 18 with both parents born outside of the host country and currently aged 16 to 65 with non-missing literacy score variable.



(b) Difference in the Mean Standardized Literacy Scores (with 95% CI) between native-speaking and non-native speaking childhood immigrants.

On the other hand, immigrants from non-native speaking countries have considerably lower standardized literacy scores after age at arrival of twelve compared to immigrants from native speaking countries.[11] This finding supports the critical age hypothesis and forms the basis of our IV strategy. We claim that the observed discontinuity in Figure 2 provides exogenous variation in language proficiency. This break reflects neuro-cognitive constraints on language acquisition rather than economic selection or cultural adaptation.

4 Empirical Strategy

In this section, we outline our empirical approach to estimating the effect of language proficiency on labor market outcomes. We begin by introducing the equation to be estimated

[11] In certain countries, such as Denmark, there are no individuals who meet the criteria for being classified as "native-speaking". Nevertheless, our sample consists of 1,627 observations, with approximately one-quarter classified as native-speaking immigrants, and analyses excluding these countries show patterns that remain consistent with those observed in Figure 2.

and discussing the related endogeneity concerns. We then present our instrumental variable (IV) strategy, detailing the exclusion restriction and other validity checks.

Our main regression model is as follows:

$$Y_{ijka} = \alpha + \beta \times LANG_{ijka} + \rho \times W_{ijka} + \delta_a + \gamma_j + \theta_k + \epsilon_{ijka} \tag{1}$$

for individual i, born in region j, immigrated to the country k at age a. Y_{ijka} is the outcome of interest, and $LANG_{ijka}$ is a measure of language proficiency (the endogenous regressor). The vector W_{ijka} contains age and gender as control variables. We account for differences between host countries in age and gender effects by including interactions between host country dummies and both age and gender.

To account for the potential direct effects of age at arrival on labor market outcomes, we include age-at-arrival fixed effects δ_a in our specifications, along with region of birth γ_j and host country fixed effects θ_k. Age-at-arrival fixed effects provide a more flexible specification than a dummy variable for arriving at an older age (Bleakley and Chin, 2010). The region of origin variable comprises nine distinct regions, as detailed in Table OA1.

Controlling for these fixed effects helps account for unobservable heterogeneity related to region of birth and host country characteristics, such as psychological and other costs associated with migration from different source regions to different host countries. The choice of source region fixed effects, as opposed to country of origin fixed effects, is due to the limited sample size in the data. Lastly, ϵ_{ijka} is the error term. We cluster standard errors three-way—by country of destination, birth region, and young arrival status (arrival before age 12)— to account for possible co-variation of outcomes within each host country, birth region and young arrival group.

Estimating the effect of language proficiency on outcomes of interest using OLS is problematic due to the endogeneity of language ability. First, unobserved factors, such as motivation, can influence both language acquisition and labor market success. Second, reverse

causality may arise if individuals improve their language skills in response to better labor market opportunities. To address these issues, we employ an instrumental variable approach. Following Bleakley and Chin (2010) and Isphording and Otten (2014), we estimate a two-stage least squares (2SLS) instrumental variable (IV) regression model to identify the causal impact of language ability on dependent variables.

The strategy we follow to build the instrument has two components. First, as shown in the previous section, the literacy score difference between childhood immigrants from native-speaking and non-native-speaking countries remains close to zero up to the age of eleven, after which it begins to diverge with age at arrival. For instance, an Austrian immigrant arriving in Germany at a very young age does not have an advantage over a Bosnian immigrant who arrives under similar conditions, since the literacy score difference between childhood immigrants from non-native and native language backgrounds is negligible up to age eleven.

Secondly, for childhood immigrants who arrive later than the critical age, those with lower linguistic distance face reduced language acquisition costs. For example, a Bosnian immigrant arriving in Germany at age 14 has a relative advantage over an Arabic immigrant arriving at the same age, as German is linguistically closer to Bosnian than to Arabic, resulting in a lower linguistic distance.

Our instrument is thus defined, similar to Isphording and Otten (2014), as the interaction of age at arrival and linguistic distance:

$$Z_{icka} = max(0, AAA_{icka} - 11) \times LD_{ick} \tag{2}$$

where AAA_{icka} refers to the age at arrival for individual i, born in country c, immigrated to the country k at age a and LD refers to the linguistic distance between the language spoken during childhood by individual i and language of destination country k. Our instrument, as defined in equation (2), differs from that used by Bleakley and Chin (2010) who substitutes the LD term with a binary variable indicating whether the immigrant's source and host country languages are the same. In both our approach and this alternative, the instrument

value is zero for native-speaking immigrants. However, for non-native-speaking immigrants, linguistic distance (LD) is continuous in equation (2), adding greater variation into the instrument.

By construction, the instrument takes a value of zero for two distinct groups: individuals who arrived in the host country at age 11 or younger, and individuals whose childhood language corresponds to the host-country language, resulting in a linguistic distance of zero.

The endogenous regressor is linked to the instrument and all other exogenous variables in the first- stage regression:

$$LANG_{icka} = \alpha + \pi \times Z_{icka} + \rho \times W_{ijka} + \delta_{1a} + \gamma_{1j} + \theta_{1k} + u_{ijka} \tag{3}$$

where Z_{icka} is the instrument. The remaining variables in equation (3) are the controls defined in the second stage equation, defined by equation (1). The coefficient π captures the impact of arrival timing relative to the critical age and the linguistic distance between the origin and host country on language proficiency. We expect the first-stage results for π to show a strong negative effect on language proficiency, indicating that later arrivals from linguistically distant countries have significantly lower language skills, consistent with the critical period hypothesis. On the other hand, the coefficient of interest is the β coefficient from the second stage regression, which reflects the language proficiency's local average treatment effect (LATE) on labor market outcomes.

The validity of this instrument hinges on the assumption that it influences the outcome only through its effect on language proficiency. This assumption holds if no other omitted factors correlated with the instrument directly impact the outcome. A potential concern is that its two components—age at arrival and linguistic distance—might correlate with other factors influencing integration outcomes. For instance, higher linguistic distance may be associated with greater cultural distance, which can raise the psychological costs of integration.

To assess whether our instrument is confounded by cultural distance, we examine the correlation between linguistic distance and cultural distance using established measures in

literature. Following the approach of Spolaore and Wacziarg (2015), we construct a cultural distance matrix between host and sending countries using World Values Survey (WVS). Our measure is based on the traditional and secular-rational values dimensions, which capture deep-rooted societal beliefs and norms. Using these standardized cultural distance values, we show that the correlation between linguistic distance and cultural distance is low (See Figure A2). Notably, this magnitude closely matches the correlation reported in the dataset provided by Spolaore and Wacziarg (2015). This suggests that the interaction between linguistic distance and age at arrival captures a distinct effect, separate from that of cultural distance, supporting the validity of our instrument. Furthermore, our results remain robust when we account for cultural distance in our main specification.

Similarly, younger and older arrivals may differ in non-linguistic factors (Friedberg, 2000), which could affect labor market outcomes; younger immigrants, for example, may be better positioned to adapt to the educational system of the host country through exposure. Furthermore, parental choices regarding the timing of the arrival of their children could be relevant. Bacolod and Rangel (2017) find that children of more educated parents tend to arrive at younger ages, although they also show that parental characteristics do not systematically vary based on the linguistic background of the children at different ages of arrival. As we show in the balance test in the previous section, parental education does not differ significantly between early and late arrivals in our context.[12] In our robustness analysis, we also control for parental education in the main specification and find that the results remain similar.

Due to the cross-sectional nature of our data, we cannot simultaneously control for current age, age at arrival, and year (or cohort) of arrival. To address this, our primary analysis includes age and age-at-arrival groups as control variables, capturing their direct effects on language acquisition and labor market outcomes. Additionally, as a robustness check,

[12]The fact that our sample is limited to individuals whose age at arrival is younger than 19 provides additional support for the inclusion of age at arrival as a component of the instrument because individuals in our sample are less likely to have control over the age at which they arrive in the host country.

we incorporate decade of arrival to control for differences in socio-economic conditions and migration policies at the time of arrival.

5 Results

5.1 First Stage Results

The first-stage results in Table 2 provide insights into the relationship between the instrument and the endogenous variable, language proficiency. The coefficient of the interaction term between age at arrival (after 11) and linguistic distance is negative and highly significant in both specifications: –0.158 in column (1), which includes the full sample, and –0.260 in column (2), which focuses on wage earners. These estimates indicate that individuals who migrate at an older age and face greater linguistic distance tend to have significantly lower literacy scores. Both coefficients are statistically significant at the 1% level, confirming a strong and robust relationship between the instrument and language proficiency. To further assess instrument strength, we report the Kleibergen–Paap Wald F-statistic under the "Weak identification test" in each table.

Table 2: First Stage Results: Age at Arrival and Language Skills

Dependent Variable	Standardized Literacy Score	
	(1)	(2)
$\max(0, \text{AAA} - 11) \times \text{LD}_{[0,1]}$	-0.158***	-0.260***
	(0.046)	(0.058)
Observations	1,434	637
R-squared	0.356	0.565

Notes: The dependent variable is the standardized PIAAC literacy score. The main regressor is the interaction between linguistic distance (rescaled to [0,1]) and age at arrival after 11. All regressions include fixed effects for age at arrival, region of birth, host country, gender, and host-country-specific age trends. Standard errors clustered at the region-of-birth × host country × early-arrival level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.2 Labor Market Outcomes

Figure 3 summarizes the main results on the relationship between language proficiency and key labor market outcomes, presenting both OLS and IV estimates. In what follows, we discuss each outcome in detail, drawing on the regression tables.

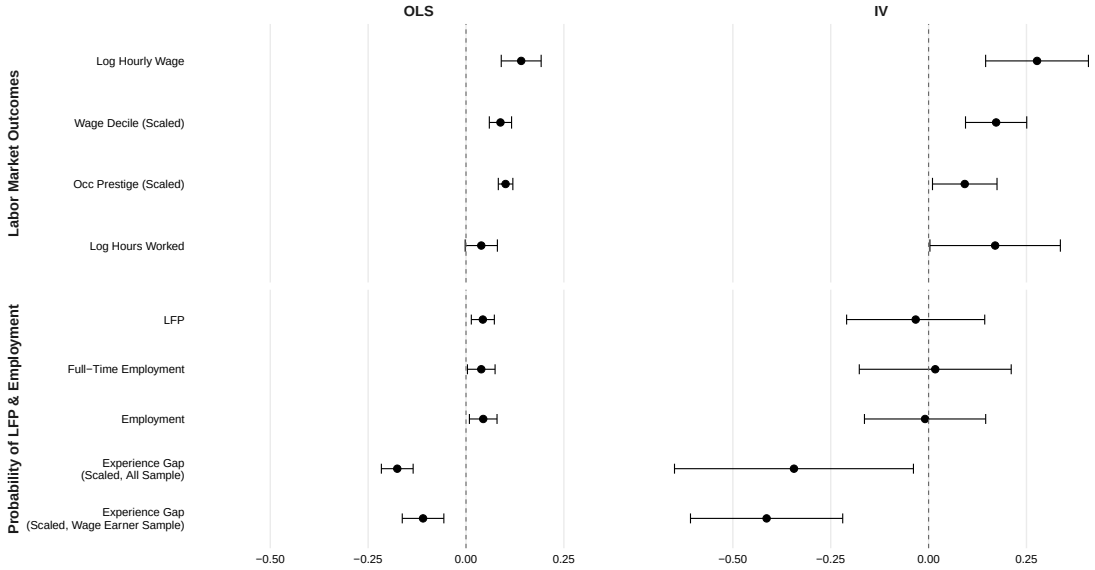
In Table 3, we present both the OLS and IV estimates for the impact of language ability on the probability of labor force participation (LFP) and employment. The OLS estimates indicate a positive association between language proficiency and the likelihood of labor force participation, employment, and full time employment at the time of the survey. In contrast, the corresponding IV estimates are smaller in magnitude and statistically insignificant, suggesting no evidence that language skills influence the composition of workers in terms of these labor market outcomes.

Table 3: Impact of Language Skill on the Probability of LFP & Employment

Dependent Variables	Labor Force Participation		Full Time Employment		Employment		Experience Gap (All Sample)		Experience Gap (Wage Earner Sample)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	0.043***	-0.033	0.039**	0.017	0.044**	-0.009	-1.756***	-3.439**	-1.097***	-4.138***
	(0.015)	(0.090)	(0.018)	(0.099)	(0.018)	(0.079)	(0.207)	(1.557)	(0.271)	(0.992)
Mean Outcome	0.70	0.70	0.41	0.41	0.52	0.52	3.97	3.97	3.97	3.97
1st Stage F-statistic	-	11.04	-	11.04	-	11.04	-	9.758	-	19.97
R-squared	0.425	0.403	0.447	0.445	0.461	0.452	0.581	0.538	0.630	0.483
Observations	1,434	1,434	1,434	1,434	1,434	1,434	1,250	1,250	635	635

Notes: See notes for Table A1 for the sample. Each regression includes age-at-arrival, region of birth, and host country dummies, along with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance to instrument language skill. Standard errors clustered at the birth region, host country, and early arrival level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 3: Language Proficiency and Labor Market Outcomes



Notes: Each regression includes age-at-arrival, region of birth, and host country fixed effects, as well as a gender dummy and age interacted with host country dummies. The 2SLS estimates use an instrument defined as $\max(0, \text{age at arrival} - 11) \times \text{Linguistic Distance}$ for language proficiency. Standard errors are clustered three-way by birth region, host country, and early arrival status. Coefficients are rescaled for comparability across outcomes: occupational prestige is divided by 100, experience gap (all) and experience gap (wage sample) are divided by 10, and wage decile is divided by 10. Confidence intervals shown are 95%.

The last four columns of Table 3 present estimates of the effect of language proficiency on the experience gap, defined as the difference between potential and actual labor market experience. The IV result in column 10 suggests a significant effect, indicating that a one-point increase in the standardized literacy score reduces the experience gap by 4.1 years. This finding suggests that higher language skills facilitate the accumulation of labor market experience. Given the null effects of language proficiency on current employment in columns (4) and (6), the negative effect on the experience gap may arise in the early stages of working life—potentially due to a faster transition into the labor market after completing formal education or less time spent between jobs—thereby enhancing on-the-job human capital accumulation.

We examine the effect of language proficiency on earnings in Table 4. The OLS estimate reveals that a one standard deviation increase in language proficiency is associated with a 14 percent increase in hourly earnings. In contrast, the IV estimate shows a more pronounced

effect, with a 28 percent increase in earnings. These results indicate that language proficiency enhances productivity and, in turn, earnings. This effect may stem from enabling immigrants to perform higher-value tasks and secure better-paying positions, which we investigate below.

The fact that our IV estimates exceed the OLS estimates for earnings and the experience gap may initially seem counterintuitive, as OLS is typically assumed to be upward biased due to unobserved ability or motivation. However, this pattern has been documented in several prior studies (Dustmann and Fabbri, 2003; Bleakley and Chin, 2004; Yao and van Ours, 2015; Guven and Islam, 2015; Tam and Page, 2016), and can be explained by several mechanisms.

Table 4: Impact of Language Skill on Labor Market Outcomes

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.141***	0.277***	0.880***	1.725***	10.110***	9.238**	0.039*	0.170**
	(0.026)	(0.067)	(0.145)	(0.399)	(0.948)	(4.205)	(0.021)	(0.085)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	19.81	-	19.81	-	19.78	-	19.81
R-squared	0.668	0.628	0.651	0.605	0.646	0.645	0.578	0.519
Observations	637	637	637	637	625	625	637	637

Notes: See notes for Table A1 for the sample. Each regression includes age-at-arrival, region of birth, and host country dummies, along with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance to instrument the language skill. Standard errors are clustered at the birth region, host country, and early arrival level (in parentheses). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

First, classical measurement error in language proficiency, due to test-day conditions, respondent fatigue, or the fact that survey questions capture literacy imperfectly, may lead to noise in literacy scores, attenuating the OLS estimates. IV estimation addresses this problem, potentially explaining the larger coefficients. Second, the IV approach identifies a local average treatment effect (LATE): the causal impact for individuals whose language

skills were influenced by the interaction of age at arrival and linguistic distance. If these individuals face higher returns to language acquisition—due to occupational upgrading or enhanced skill utilization—then the IV estimates may naturally exceed the OLS estimates.

Finally, as noted by Bleakley and Chin (2004), endogeneity in language acquisition may stem not only from innate ability but also from unobserved traits, such as motivation. Immigrants who arrive with lower language proficiency may recognize that, in comparison to individuals with stronger language skills but similar non-language human capital, they must exert greater effort to achieve labor market integration. If such compensatory effort is positively rewarded, OLS estimates of the returns to language proficiency may be biased downward. Taken together, these explanations provide a coherent rationale for the observed gap between IV and OLS estimates in our study.

Columns 5 and 6 examine occupational prestige, which also captures the non-pecuniary aspects of jobs. In column 5, the result shows a significant relationship between language proficiency and occupational prestige. Occupational prestige values range from 15 to 79 in our sample with a standard deviation of 20. The OLS estimate indicates that a one-point increase in the standardized literacy score corresponds to a 10.1-point increase in occupational prestige, while the IV estimate in column 6 shows a slightly lower but still substantial effect of 9.2 points. This finding supports the notion that language proficiency improves job quality and occupational standing, allowing immigrants to attain roles with higher prestige.

The impact of language proficiency on hours of work is also notable. The IV estimate in Column 8 reveals that a one standard deviation increase in language score leads to a 17 percentage point increase in weekly work hours, which is 13 percentage points higher than the OLS estimate. This significant effect suggests that language proficiency not only improves job quality but also increases hours of work. Hence, individuals with higher language proficiency seems to be responding to resulting increase in wages by increasing their work hours.

5.3 Task Employment at Work

Table 5 provides insights into how language proficiency influences various indices of job task performance, including reading, writing, influencing others at work, abstract tasks, and physically demanding work.

The results indicate a significant effect of language ability on job tasks that involve reading. According to column 1, a one-point increase in the standardized literacy score is associated with a 0.6-point increase in the reading task index. This finding is reinforced by the IV estimate in column 2, which indicates a 0.7-point increase in the use of reading tasks at work. This effect size corresponds to slightly more than one-third of the sample's standard deviation for the reading task index. These findings underscore the importance of language proficiency in roles that require strong reading skills, highlighting the role of language ability in performing complex and information-intensive tasks. In contrast, while the OLS estimation indicates a positive relationship between language proficiency and writing tasks, the IV estimate shows no significant effect. This discrepancy suggests that the relationship between language proficiency and writing tasks is more nuanced, potentially influenced by factors other than language ability.

The ability to influence others at work is an important dimension of tasks employed at work, reflecting one's capacity for persuasive and effective communication—key for roles involving leadership, negotiation, or coordination. Language proficiency can strengthen this skill through enhanced verbal communication. In column 5 of Table 5, a one-standard-deviation increase in language score is associated with a 0.4-point increase in the "influencing others" index. The IV estimate in column 6 shows an even larger effect, indicating a 0.7-point increase per standard deviation in language proficiency. This finding aligns with the conceptual framework, which emphasizes the role of language skills in facilitating higher-level cognitive and social functions in the workplace.

The next two tasks we examine are the abstract tasks and physical work. The results for abstract tasks indicate that a one-standard deviation increase in language proficiency

is associated with a 0.9-point increase in the abstract skills index. This finding suggests that higher language skills are linked to an increased engagement in complex, cognitive tasks that require higher-level reasoning and problem-solving. This supports the theoretical perspective that advanced language skills facilitate engagement in more sophisticated and cognitively demanding job roles.

Table 5: Impact of Language Skill on Tasks Employed at Work

Dependent Variables	Reading		Writing		Influence		Abstract		Physical Work	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	0.626***	0.739**	0.509***	0.202	0.437***	0.713*	0.585***	0.912***	-0.179***	-0.242**
	(0.088)	(0.350)	(0.093)	(0.290)	(0.071)	(0.371)	(0.063)	(0.315)	(0.024)	(0.102)
Mean Outcome	-0.06	-0.06	0.10	0.10	-0.18	-0.18	-0.25	-0.25	0.5	0.5
(Std Dev)	(1.68)	(1.68)	(1.38)	(1.38)	(1.34)	(1.34)	(1.32)	(1.32)	(0.5)	(0.5)
1st Stage F-statistic	-	19.81	-	19.81	-	20.07	-	19.81	-	19.81
R-squared	0.615	0.613	0.576	0.553	0.563	0.543	0.615	0.587	0.575	0.568
Observations	637	637	637	637	633	633	637	637	637	637

Notes: See notes for Table A1 for the sample. Each regression includes age-at-arrival, region of birth, and host country dummies, with a gender dummy and age interacted with host country dummies. The 2SLS estimate uses the variable max(0, age at arrival − 11) × Linguistic Distance as an instrument for language skill. Task variables were created using Principal Component Analysis. Physical Work is a dummy variable equal to 1 if an individual reports daily physical work; 0 otherwise. Writing and Reading are based on various tasks coded in G_Q02 and G_Q01 variables. Influence and Abstract tasks are based on F_Q02, F_Q03, and F_Q04 variables. Standard errors clustered at the birth region, host country, and early arrival level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Conversely, the results indicate that higher language proficiency reduces the likelihood of engaging in physically demanding work. Specifically, column 10 shows that a one-standard deviation increase in language proficiency leads to 24 percentage-point decrease in the probability of working physically long hours. This negative effect indicates that advanced language skills may allow individuals to shift towards more complex, non-physical roles. This finding aligns with task-based labor market theories, which posit that higher language proficiency correlates with less physically intensive and more intellectually demanding tasks, thereby enhancing occupational status, as explored in the previous section.

In summary, the results from Table 5 highlight the critical role of language proficiency in enhancing task performance and overall job quality. These findings support the conceptual framework, emphasizing that language skills are essential for effectively leveraging human capital and achieving better labor market outcomes.

We also examine task intensity indices of analytical, interactive, and manual tasks using O*NET database. The results, presented in the appendix Table OA11, align with the findings from PIAAC task indices and are consistent with those of Adserà and Bhowmick (2022).

5.4 Educational Mismatch

Table 6 explores how language proficiency affects education-job mismatch among childhood immigrants, examining three scenarios: being well-qualified, under-qualified, and over-qualified. The results offer important insights into how language skills influence job matching and the effective utilization of educational qualifications.

The 2SLS estimate in column 2 shows that a one-standard deviation increase in language proficiency reduces the likelihood of being over-qualified by 12.7 percentage points. This finding is in line with Santiago and Carlos (2021), who reported a negative link between language skills and over-qualification in Australia. Column 6 indicates that language proficiency also reduces the likelihood of being under-qualified. However, this result differs from Santiago and Carlos (2021), who found no significant effect using 2SLS estimates. The reductions in over-qualification and under-qualification suggest that higher language ability enhances the alignment between an immigrant's skills and job requirements. Consistent with these findings, column 4 shows that a one-standard deviation increase in language proficiency raises the likelihood of being well-qualified by 46.9 percentage points.

In summary, the findings highlight the vital role of language proficiency in reducing education-job mismatch and improving the effective utilization of skills in the labor market. Stronger language skills enable immigrants to navigate the job market more effectively, communicate their qualifications clearly, and perform job-specific tasks with greater proficiency.

Table 6: Impact of Language Skill on Qualification Mismatch

Dependent Variables	Over-qualified		Well-qualified		Under-qualified	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy Score	0.030	-0.127*	0.079**	0.469***	-0.109***	-0.341***
	(0.019)	(0.065)	(0.032)	(0.143)	(0.026)	(0.111)
Mean Outcome	0.07	0.07	0.66	0.66	0.27	0.27
1st Stage F-statistic	-	19.81	-	19.81	-	19.81
R-squared	0.435	0.254	0.484	0.171	0.546	0.419
Observations	637	637	637	637	637	637

Notes: See notes for Table A1 for the sample. Each regression includes age-at-arrival, region of birth, and host country dummies, with a gender dummy and age interacted with host country dummies. The 2SLS estimate uses the variable max(0, age at arrival − 11) × Linguistic Distance as an instrument for language skill. Required schooling is defined by the one-standard-deviation range around the mean schooling level within each occupation. Overqualified: 1 if years of schooling exceed the range; 0 otherwise. Well-qualified: 1 if years of schooling is within the range; 0 otherwise. Under-qualified: 1 if years of schooling is below the range; 0 otherwise. Standard errors clustered at the birth region, host country, and early arrival level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.5 Mediator Analysis: Schooling as a Mediator

Bleakley and Chin (2004) propose that schooling could mediate the effect of language ability on earnings, suggesting that individuals with lower language proficiency may incur higher education costs. To investigate this hypothesis, we employed a 2SLS estimation to assess the impact of language ability on hourly earnings, controlling for years of schooling.

The first two columns of Table 7 provide estimates on how higher language proficiency may facilitate skill acquisition through schooling. The OLS estimate in column 1 shows that a one-point increase in the standardized literacy score is associated with an additional 1.53 years of education, while the IV estimate suggests an even larger effect, with 2.26 additional years. Thus, consistent with the conceptual framework, language proficiency boosts human capital accumulation through both formal education and on-the-job experience.

Column 3 of Table 7 where we present the OLS coefficient estimates for schooling and literacy scores show that both coefficients are significant. This indicates that literacy skills

are not simply picking up the variation in schooling. In the IV specification presented in column 4 of Table 7, the coefficient for language ability on earnings remains similar to the estimates from Table 4. This result challenges the hypothesis proposed by Bleakley and Chin (2004), based on the U.S. context, that years of schooling is the main mediating factor and shows that for a given schooling level individuals with higher language skills get higher returns in the labor market. Our findings are more in line with Guven and Islam (2015), who studied Australia and found that the relationship between language ability and earnings does not change after controlling for years of schooling. Additionally, when we control for the highest degree of education, the results for labor market outcomes remain similar to those in Table 7 (See Table OA3 in online Appendix).

Table 7: Impact of Language Skill on Labor Market Outcomes controlling for Years of Schooling

Dependent Variables	Years of Schooling		Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	1.539***	2.261***	0.079***	0.257**	0.380**	1.386**	5.279***	0.268	0.014	0.211
	(0.156)	(0.346)	(0.025)	(0.114)	(0.153)	(0.643)	(1.015)	(7.179)	(0.025)	(0.138)
Year of Schooling			0.040***	0.008	0.325***	0.141	3.119***	4.021***	0.016*	-0.019
			(0.007)	(0.023)	(0.043)	(0.122)	(0.462)	(1.202)	(0.009)	(0.024)
Mean Outcome	11.90	11.90	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	19.97	-	12.42	-	12.42	-	12.57	-	12.42
R-squared	0.722	0.700	0.690	0.641	0.694	0.647	0.719	0.697	0.584	0.487
Observations	637	637	637	637	637	637	625	625	637	637

See notes for Table A1 for the sample. Each regression includes age-at-arrival, region of birth, and host country dummies with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance to instrument the language skill. "Years of Schooling" refers to the total years of formal education completed. Occ Prestige is an occupational prestige score calculated by Ganzeboom and Treiman's (2010) International Stratification and Mobility File with 2-digit ISCO codes. Standard errors are clustered at the birth region, host country, and early arrival level (in parentheses). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

One possible explanation for this divergence is that the relationship between formal schooling and earnings may be shaped by institutional factors in European labor markets, rather than reflecting a universally low return to education. In particular, heterogeneity in educational quality, and limited recognition of foreign credentials may reduce the extent

to which schooling translates into higher earnings for immigrants. These constraints can weaken the role of formal education as a channel for labor market integration—especially when qualifications are obtained abroad.

To explore this possibility, we separately control for years of schooling completed in the host country and in the country of origin. The results, shown in Table OA4 in online Appendix, remain unchanged: language proficiency continues to have a strong and significant effect on earnings. While, as expected, the coefficient for host country education is larger in magnitude, neither type of schooling significantly predicts wages in our IV specification. This finding suggests that the observed effect of language proficiency is not merely capturing the returns to host-country education, but reflects an independent influence on labor market integration.

We also examine occupational prestige scores in Table 7. After controlling for schooling, the effect of language ability becomes quite small and statistically insignificant. This suggests that years of schooling may influence the types of occupations childhood immigrants enter, even if they do not translate directly into higher earnings. In sum, our findings indicate that the impact of language ability on labor market outcomes in the European context likely operates through pathways beyond formal education—such as field of study, credential signaling, job search behavior, and task performance.

5.6 Robustness Analysis

We begin our robustness analysis with a placebo test that examines whether our instrumental variable predicts labor market outcomes among second-generation immigrants. Since these individuals are born in the host country, we re-estimate the 2SLS model using linguistic distance as the sole instrument in this subsample. The instrument shows no meaningful first-stage relevance, and the 2SLS estimates are statistically insignificant, while the OLS estimates remain positive and significant. This pattern, reported in Table OA2, suggests that the OLS results may capture unobserved confounders, such as parental background or

cultural capital, rather than a causal relationship.

We conduct further robustness analyses to address the validity of our instrument, and to test sensitivity of our results to sample choice and variable definitions. First, we re-estimate the models controlling for parental education. Böhlmark (2009) demonstrates that the coefficients from the cross-sectional analysis including parental education and country of origin are remarkably similar to those from the sibling fixed effect analysis. Our main findings remain robust to including parental education controls (See Table OA5, OA12 and OA15 in online Appendix).

Second, we re-estimate the models excluding childhood immigrants originating from Western European and North American countries to test whether these individuals drive the outcomes (See Table OA6 and OA13 in online Appendix). These immigrants may find it easier to integrate into host countries due to lower linguistic distance and greater cultural similarity(Adserà and Pytliková, 2015). Compared to the main sample results, the coefficient of interest increases in magnitude, indicating that the findings in the main results section are not primarily driven by childhood immigrants from Western European and North American countries.

Third, we control for year of arrival to account for the changing labor market conditions across different arrival years (See Table OA7 in online Appendix). Results are robust except for occupational prestige scores.

Fourth, following Adserà and Bhowmick (2022) to capture potential non-linearity in the relation between age at migration and language proficiency, we employ three instruments instead of one. Specifically, we interact linguistic distance (LD) with the following age at arrival indicators: 0-7, 8-11, 12-18. The results for labor market outcomes remain robust when using these alternative instruments (See Table OA8 in online Appendix). However, first-stage F-statistic values become smaller than 10 which we attribute to the small size of our sample.

Fifth, for the education-job mismatch outcomes, the range around mean that we use

to define over- and underqualification might be sensitive to outliers. Therefore, we do the same analysis with the range around median and modal values of years of education for each occupation (See Table OA16, OA17 in online Appendix). Our findings remain robust to different definitions of the education-job mismatch outcomes.

Sixth, we investigate the main labor market outcomes and tasks at job considering a different critical age found in the literature (Bleakley and Chin, 2010). Our results remain robust to the critical age assumption of 10 (See Table OA9, OA14 in online Appendix).

Finally, we re-estimate the models while controlling for cultural distance between the host and sending countries. Our findings remain robust, confirming that the observed effects of language proficiency are not driven by underlying cultural factors (See Table OA10 in online Appendix).

Robustness results are visualized in online Appendix Figures which show consistent estimates across labor market outcomes, job tasks, and qualification mismatch definitions.

6 Summary and Conclusion

In this paper, we study the impact of language skills on human capital accumulation, labor market outcomes, and job characteristics of childhood immigrants. Unlike previous studies that focus on a single host country, our analysis is set within a multinational European context. Using PIAAC data, which provides objective measures of language skills, we adopt an instrumental variable strategy based on the critical age hypothesis and linguistic distance. While we analyze outcomes commonly explored in existing literature, we also introduce unique measures, including worker-reported job tasks and actual labor market experience, studied here for the first time.

We find that language proficiency increases hourly earnings and weekly hours of work but does not significantly affect labor force participation and employment. Additionally, higher language skills reduces the gap between potential and actual labor market experience, sug-

gesting an increase of on-the-job human capital accumulation. Regarding formal schooling, we find positive effects of language proficiency on years of schooling. However, we find no evidence that schooling is a significant mediator for the effect of language skills on earnings within the European context.

Our findings further highlight the role of language skills in shaping job characteristics: higher language proficiency leads to increased occupational prestige and influences the nature of tasks performed. Specifically, using worker reported tasks performed at job, we find that that language proficiency enhances engagement in reading, abstract tasks, and influencing others while reducing involvement in physically demanding tasks. Lastly, we document that language ability improves education-job match.

These results indicate that language ability plays an important role in improving economic integration of childhood immigrants. In particular, our results reveal that language ability is instrumental in enhancing immigrant skills and their effective utilization in the European context. Our results suggest that there may be channels other than years of schooling that language ability enhances integration of immigrants. Changes in school type and field of study, improved communication skills, more effective job search, reduced discrimination may be other potential mediators that require additional future work.

In immigrant host countries, language training programs have become central to integration policies. Recent studies study effectiveness of these programs and highlight the importance of program intensity, particularly in terms of duration, for labor market integration (Lochmann et al., 2019; Foged et al., 2023, 2024; Heller and Mumma, 2023; Pont-Grau et al., 2023). From a policy standpoint, our findings suggest that, among childhood immigrants, the returns to language training programs may be especially high for those arriving at later ages. This indicates that age-specific approaches to language training could enhance the effectiveness of these programs in supporting integration.

References

Acemoglu, D. and Autor, D. (2011). Skills, Tasks and Technologies: Implications for Employment and Earnings. In Ashenfelter, O. and Card, D., editors, *Handbook of Labor Economics*, volume 4 of *Handbook of Labor Economics*, chapter 12, pages 1043–1171. Elsevier.

Adserà, A. and Bhowmick, A. (2022). English Proficiency, Gender and the Occupations of Childhood Immigrants in the US. *Journal of Labor Research*, 43(3):321–344.

Adserà, A. and Pytliková, M. (2015). The Role of Language in Shaping International Migration. *The Economic Journal*, 125(586):F49–F81.

Agasisti, T., Johnes, G., and Paccagnella, M. (2021). Tasks, occupations and wages in OECD countries. *International Labour Review*, 160(1):85–112.

Autor, D. H. and Handel, M. J. (2013). Putting Tasks to the Test: Human Capital, Job Tasks, and Wages. *Journal of Labor Economics*, 31(2):S59–S96.

Bacolod, M. and Rangel, M. A. (2017). Economic Assimilation and Skill Acquisition: Evidence From the Occupational Sorting of Childhood Immigrants. *Demography*, 54(2):571–602.

Beck, A., Corak, M., and Tienda, M. (2012). Age at Immigration and the Adult Attainments of Child Migrants to the United States. *The Annals of the American Academy of Political and Social Science*, 643(1):134–159.

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education, First Edition*. Number beck-5 in NBER Books. National Bureau of Economic Research, Inc.

Bleakley, H. and Chin, A. (2004). Language skills and earnings: Evidence from childhood immigrants. *The review of economics and statistics*, 86(2):481–496.

Bleakley, H. and Chin, A. (2010). Age at Arrival, English Proficiency, and Social Assimilation Among US Immigrants. *American economic journal. Applied economics*, 2(1):165–192.

Böhlmark, A. (2009). Integration of childhood immigrants in the short and long run — swedish evidence. *International Migration Review*, 43(2):387–409.

Cassidy, H. (2019). Occupational attainment of natives and immigrants: A cross-cohort analysis. *Journal of Human Capital*, 13(3):375–409.

Chiswick, B. and Miller, P. (2001). A model of destination-language acquisition: Application to male immigrants in canada. *Demography*, 38:391–409.

Chiswick, B. and Repetto, G. (2000). Immigrant adjustment in israel: Literacy and fluency in hebrew and earnings. IZA Discussion Papers 177, Institute of Labor Economics (IZA).

Chiswick, B. R. and Miller, P. W. (2014). International Migration and the Economics of Language. IZA Discussion Papers 7880, Institute of Labor Economics (IZA).

Daley, A., Hu, M., and Warman, C. (2019). Language proficiency and immigrants' economic integration. *IZA World of Labor*, pages 469–469.

Dustmann, C. (1994). Speaking fluency, writing fluency and earnings of migrants. *Journal of Population Economics*, 7(2):133–56.

Dustmann, C. and Fabbri, F. (2003). Language Proficiency and Labour Market Performance of Immigrants in the UK. *The Economic Journal*, 113(489):695–717.

Dustmann, C. and van Soest, A. (2001). Language Fluency And Earnings: Estimation With Misclassified Language Indicators. *The Review of Economics and Statistics*, 83(4):663–674.

Espenshade, T. J. and Fu, H. (1997). An analysis of english-language proficiency among u.s. immigrants. *American Sociological Review*, 62:288–305.

Foged, M., Hasager, L., Peri, G., Arendt, J. N., and Bolvig, I. (2023). Intergenerational spillover effects of language training for refugees. *Journal of Public Economics*, 220:104840.

Foged, M., Hasager, L., Peri, G., Arendt, J. N., and Bolvig, I. (2024). Language training and refugees' integration. *The Review of Economics and Statistics*, 106(4):1157–1166.

Foged, M. and van der Werf, C. (2023). Access to language training and the local integration of refugees. *Labour Economics*, 84(C).

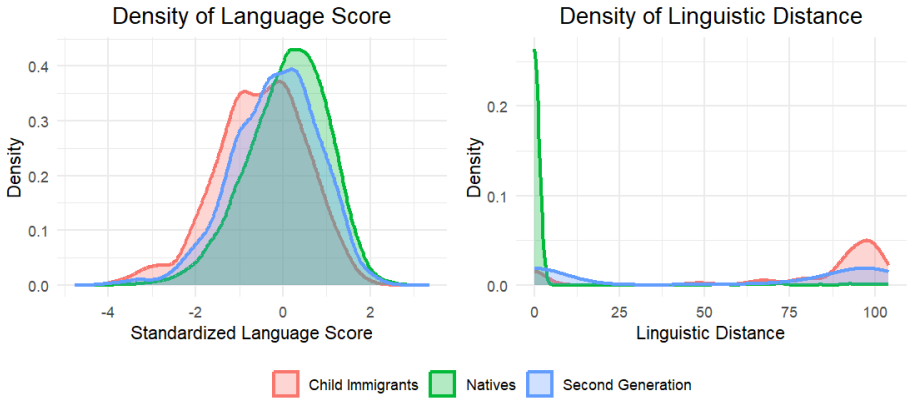
Friedberg, R. M. (2000). You can't take it with you? immigrant assimilation and the portability of human capital. *Journal of Labor Economics*, 18(2):221–251.

Ganzeboom, H. (2010). A new international socio-economic index (isei) of occupational status for the international standard classification of occupation 2008 (isco-08) constructed with data from the issp

2002–2007. In *Annual Conference of International Social Survey Programme, Lisbon, May 1 2010*.
Guven, C. and Islam, A. (2015). Age at Migration, Language Proficiency, and Socioeconomic Outcomes: Evidence From Australia. *Demography*, 52(2):513–542.
Hanushek, E. A., Schwerdt, G., Wiederhold, S., and Woessmann, L. (2015). Returns to skills around the world: Evidence from piaac. *European Economic Review*, 73:103–130.
Heller, B. H. and Mumma, K. S. (2023). Immigrant integration in the united states: The role of adult english language training. *American Economic Journal: Economic Policy*, 15(3):407–37.
Isphording, I. and Otten, S. (2011). Linguistic distance and the language fluency of immigrants. Ruhr Economic Papers 274, RWI - Leibniz-Institut für Wirtschaftsforschung, Ruhr-University Bochum, TU Dortmund University, University of Duisburg-Essen.
Isphording, I. E. (2013). Returns to foreign language skills of immigrants in spain. *LABOUR*, 27(4):443–461.
Isphording, I. E. and Otten, S. (2014). Linguistic barriers in the destination language acquisition of immigrants. *Journal of economic behavior & organization*, 105:30–50.
Isphording, I. E. and Sinning, M. (2012). The returns to language skills in the us labor market. *IZA Discussion Paper*, 123(2):236–239.
Kim, D.-H., Deng, R., and Rambaldi, A. N. (2025). Economic costs of language barriers for immigrants with different linguistic origins. Available at SSRN: https://ssrn.com/abstract=4735599.
Lenneberg, E. (1967). Biological foundations of language. *Wiley*.
Leuven, E. and Oosterbeek, H. (2011). Overeducation and mismatch in the labor market. In *Handbook of The Economics of Education*, volume 4, chapter Chapter 3, pages 283–326. Elsevier.
Liao, C.-W., Qu, Y., and Morgan, R. (2010). The relationships of test scores measured by the toeic listening and reading test and toeic speaking and writing tests. *TOEIC Compendium Study*, 10:1–15.
Lochmann, A., Rapoport, H., and Speciale, B. (2019). The effect of language training on immigrants' economic integration: Empirical evidence from france. *European Economic Review*, 113:265–296.
McGuinness, S., Pouliakas, K., and Redmond, P. (2018). Skills mismatch: Concepts, measurement and policy approaches. *Journal of Economic Surveys*, 32(4):985–1015.
Mueller, R. E. and Truong, N. T. K. (2022). Wage and basic skills inequality between immigrants by immigration admission categories and Canadian non-immigrants. *Empirical Economics*, 62(4):1833–1884.
Newport, E. L. (2002). Critical periods in language development. *Encyclopedia of Cognitive Science. London: MacMillan Publishing Ltd./Nature Publishing Group*.
Pont-Grau, A., Lei, Y.-H., Lim, J. Z., and Xia, X. (2023). The effect of language training on immigrants' integration: Does the duration of training matter? *Journal of Economic Behavior & Organization*, 212:160–198.
Santiago, B. and Carlos, M.-d.-I. (2021). Education and skill mismatches among immigrants: The impact of host language proficiency. *Economics of Education Review*, 84:102–145.
Schmid, L. (2023). The impact of host language proficiency on migrants' employment outcomes. *American Economic Review: Insights*, 5(4):477–93.
Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics*, 87(3):355–374.
Spolaore, E. and Wacziarg, R. (2015). Ancestry, language and culture. NBER Working Papers 21242, National Bureau of Economic Research, Inc.
Sweetman, A. and van Ours, J. C. (2015). Chapter 21 - immigration: What about the children and grandchildren? In Chiswick, B. R. and Miller, P. W., editors, *Handbook of the Economics of International Migration*, volume 1 of *Handbook of the Economics of International Migration*, pages 1141–1193. North-Holland.
Tam, K. W. and Page, L. (2016). Effects of language proficiency on labour, social and health outcomes of immigrants in Australia. *Economic Analysis and Policy*, 52:66–78.
Yao, Y. and van Ours, J. C. (2015). Language skills and labor market performance of immigrants in the Netherlands. *Labour Economics*, 34(C):76–85.

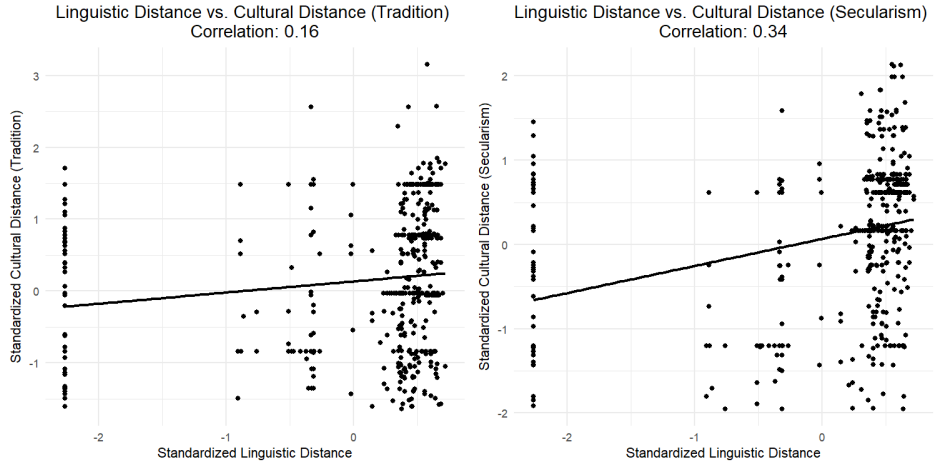
Appendix

Figure A1: Densities: Language Score and Linguistic Distance



Note: Kernel density plots compare standardized literacy scores (left) and linguistic distance (right) across three groups: first-generation immigrants (arrived before age 19 with both parents foreign-born), second-generation immigrants (native-born with at least one foreign-born parent), and natives (native-born with native-born parents). The sample includes individuals aged 16 to 65 with non-missing values for wage, literacy score, age at arrival, years of schooling, region of birth, and linguistic distance. Literacy scores are standardized within each host country.

Figure A2: Correlation: Linguistic Distance and Cultural Distance



Note: Correlation and scatter plots refer to childhood immigrants. The sample consists of first-generation childhood immigrants arrived in the host country by age 18 with both parents born outside of the host country and currently aged 16 to 65 with non-missing wage, literacy score, age at arrival, years of schooling, region of birth and linguistic distance variables.

Table A1: Balance Test for Characteristics

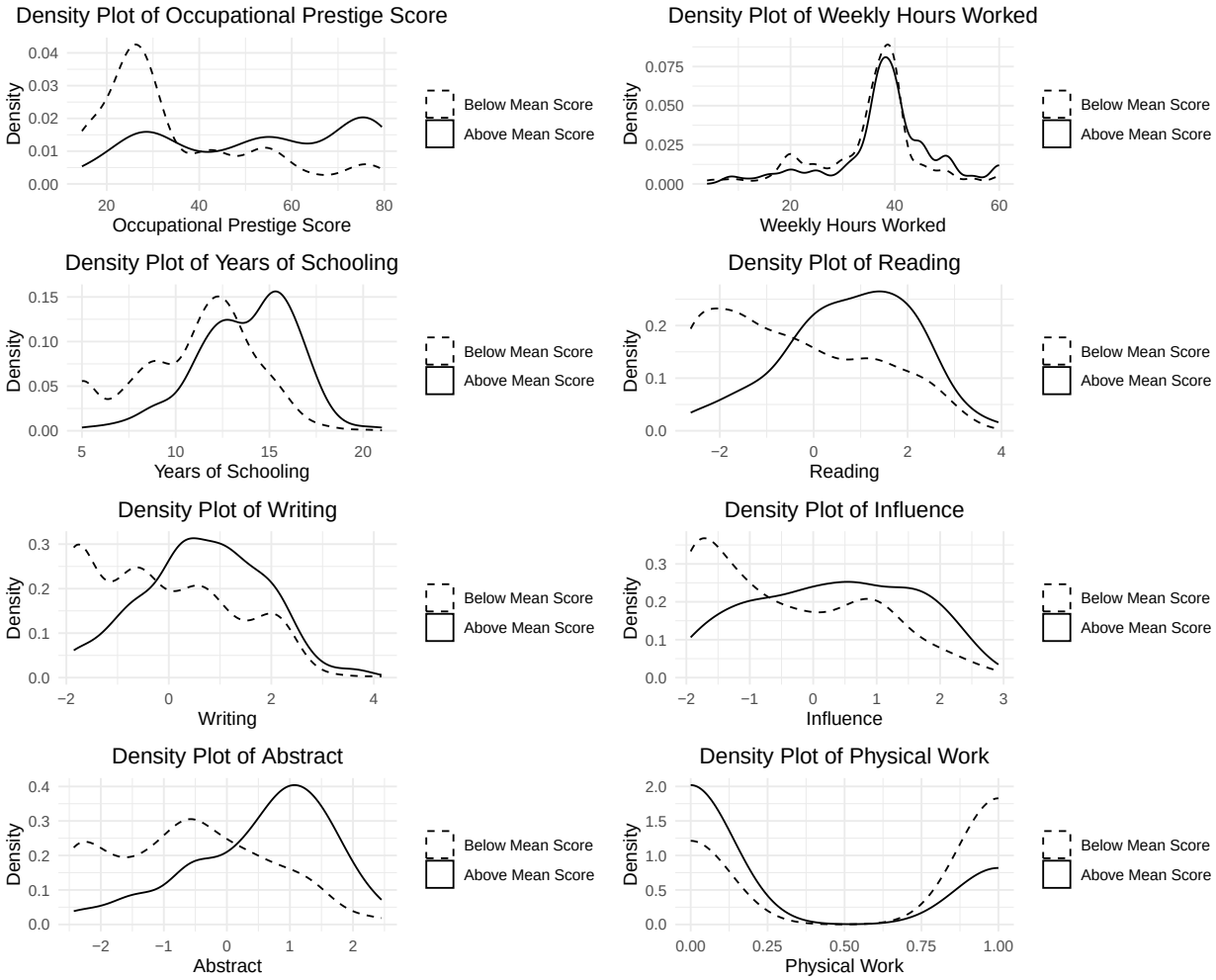
Variable	(1) Young Arrivers (0-11)	(2) Old Arrivers (12-18)	(3) Difference
Age	36.513	37.525	1.012
	(11.625)	(11.674)	(0.930)
Gender (Female)	0.431	0.450	0.019
	(0.496)	(0.498)	(0.040)
Years of Schooling	12.062	11.700	-0.362
	(3.133)	(3.440)	(0.261)
Mother's Education			
Less than High School	0.611	0.611	0.000
	(0.488)	(0.488)	(0.039)
High School	0.224	0.229	0.004
	(0.418)	(0.421)	(0.033)
More than High School	0.112	0.125	0.013
	(0.316)	(0.331)	(0.026)
Father's Education			
Less than High School	0.473	0.479	0.005
	(0.500)	(0.500)	(0.040)
High School	0.286	0.282	-0.004
	(0.452)	(0.451)	(0.036)
More than High School	0.174	0.189	0.016
	(0.379)	(0.392)	(0.031)
Observations	357	280	637

Notes: Standard deviations in parentheses. The sample consists of first-generation childhood immigrants arrived in the host country by age 18 with both parents born outside of the host country and currently aged 16 to 65 with non-missing wage, literacy score, age at arrival, years of schooling, region of birth and linguistic distance variables.

Online Appendix

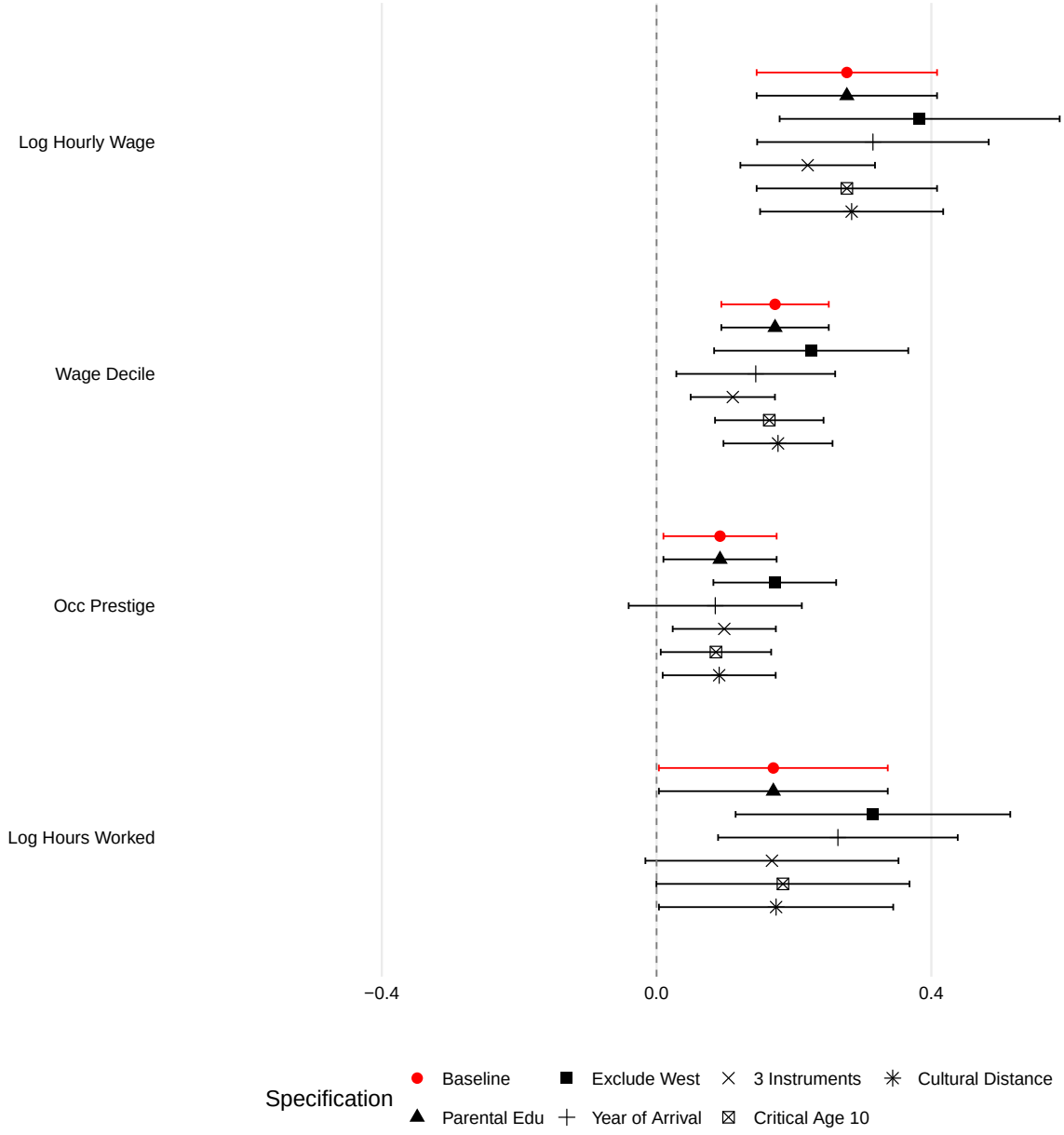
Online Appendix: Figures

Figure OA1: Kernel Density Plots of Variables



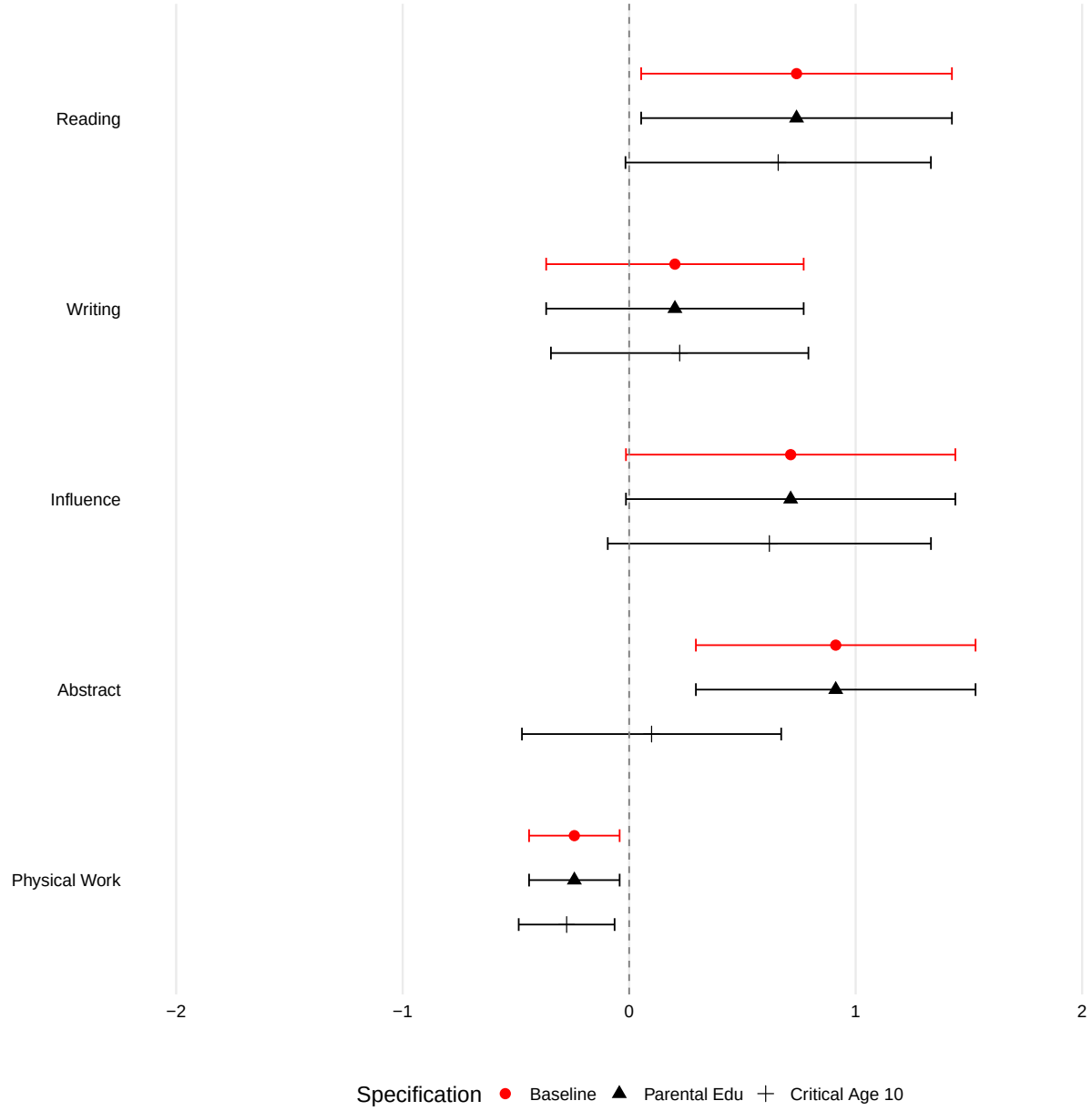
Note: The figures present distributions of occupational prestige, weekly hours worked, years of schooling, and various job tasks (reading, writing, influencing others, abstract, and physical work). Kernel density plots compare childhood immigrants above and below the mean standardized literacy score. The sample includes first-generation childhood immigrants who arrived by age 18, have both parents born abroad, and are currently aged 16–65 with non-missing data.

Figure OA2: Robustness of Language Proficiency Effects on Labor Market Outcomes



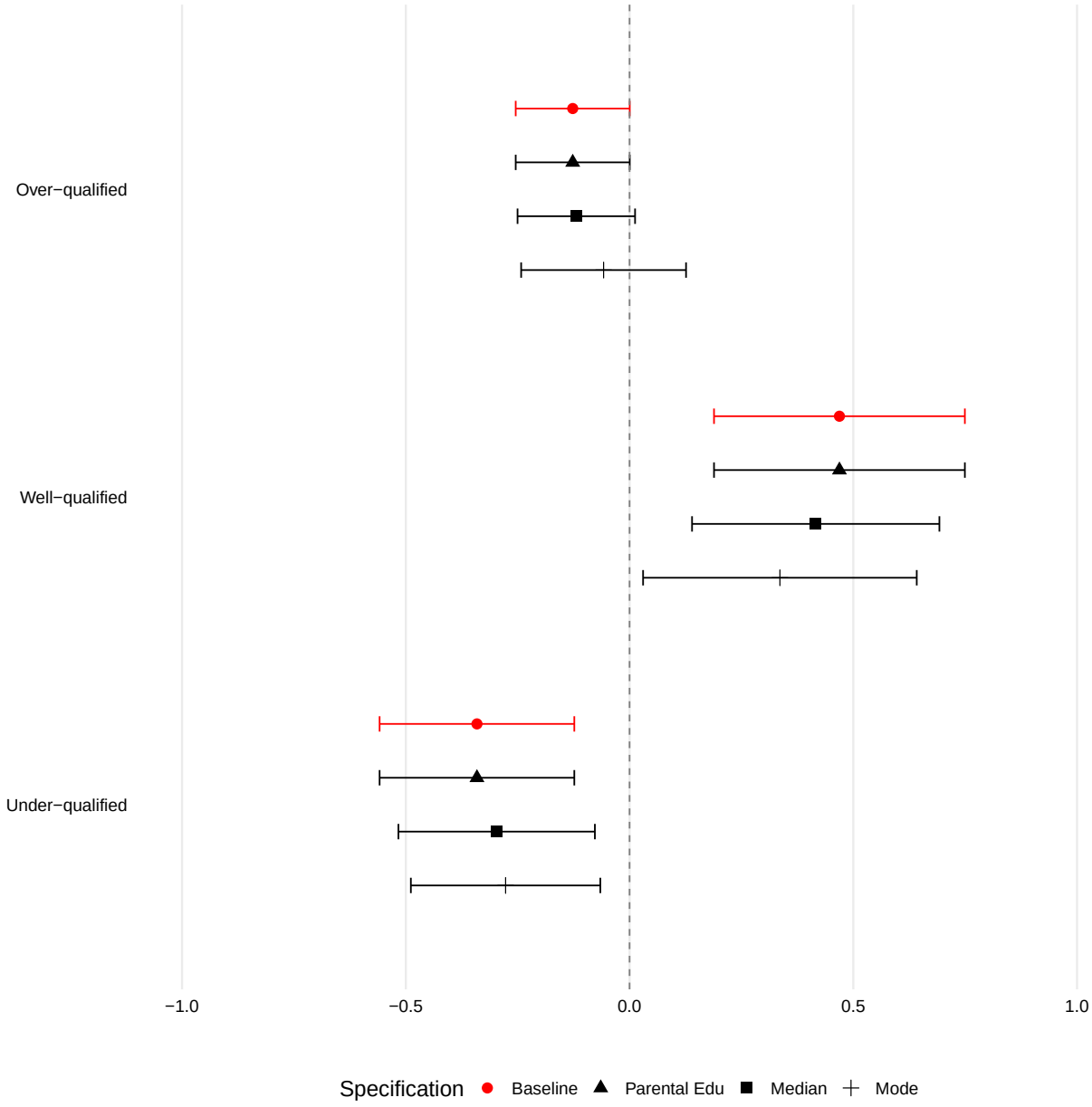
Notes: Each regression includes age-at-arrival, region-of-birth, and host country fixed effects, as well as a gender dummy and age interacted with host country dummies. The 2SLS estimates use the instrument $\max(0, \text{age at arrival} - 11) \times \text{Linguistic Distance}$. Standard errors are clustered three-way by birth region, host country, and early arrival status. Confidence intervals are 95%.

Figure OA3: Robustness of Language Proficiency Effects on Job Task Outcomes



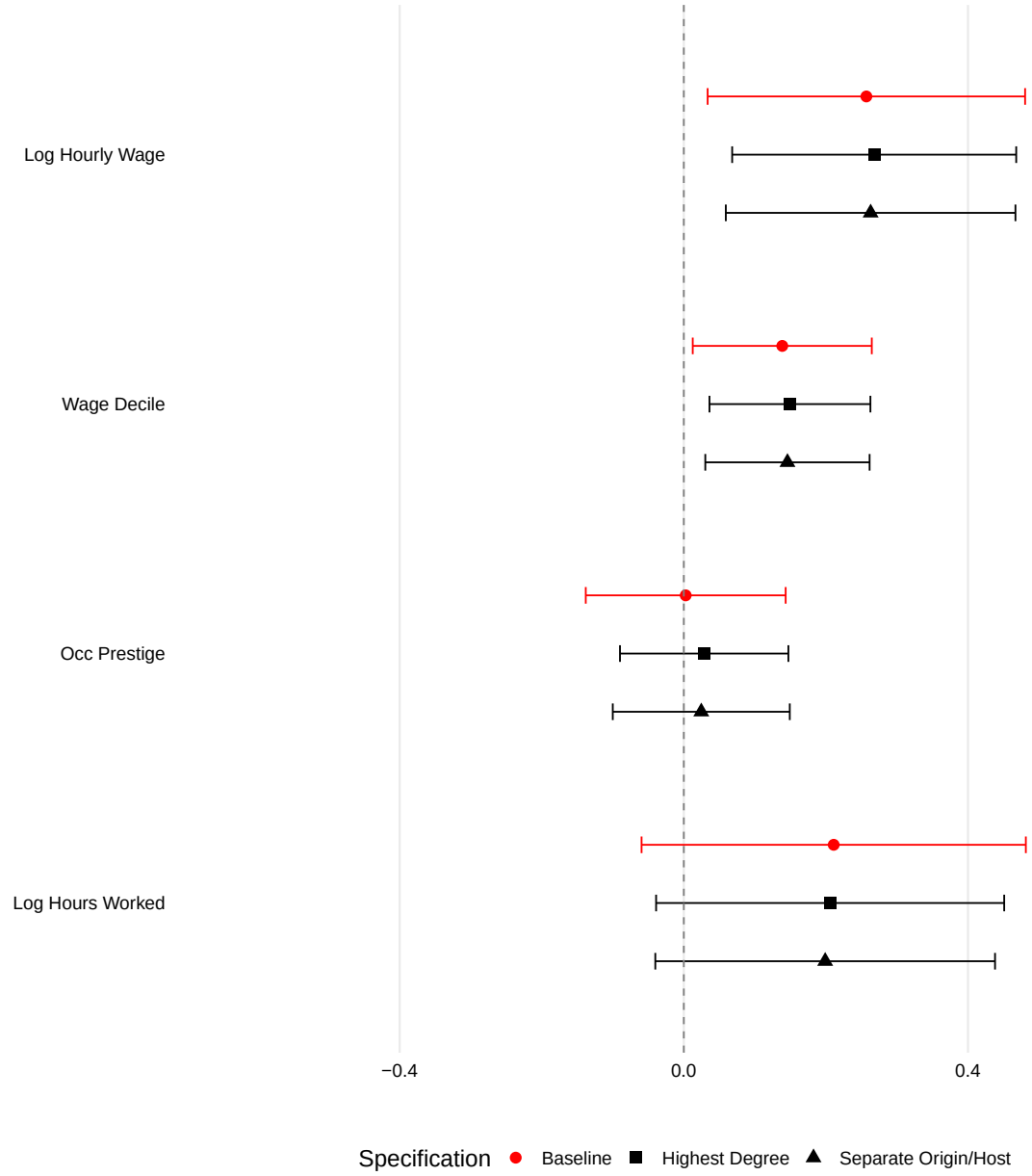
Notes: Same specification as Figure OA2.

Figure OA4: Robustness of Language Proficiency Effects on Education–Job Match



Notes: Same specification as Figure OA2.

Figure OA5: Robustness of Mediator Analysis



Notes: Same specification as Figure OA2.

Online Appendix: Tables

Table OA1: Immigrant Share by Birth Region and Country

Panel A

Birth Region	**Austria**	**Belgium**	**Denmark**	**France**
Arab States	1.07	6.22	7.44	18.20
South and West Asia	1.98	1.56	9.90	0.88
Latin America and the Caribbean	0.91	0.16	2.69	1.13
Sub-Saharan Africa	0.99	1.09	5.04	7.62
East Asia and the Pacific (poorer countries)	1.24	0.62	7.21	2.96
Central Asia	0.41	0.93	0.52	0.19
East Asia and the Pacific (richer countries)	0.17	0.00	0.69	0.06
Central and Eastern Europe	34.71	12.60	23.93	4.72
North America and Western Europe	58.51	76.83	42.59	64.23
Total	100	100	100	100
Immigrant Population in the Country	**23.59 %**	**11.97%**	**23.89 %**	**22.86 %**

Panel B

Birth Region	**Germany**	**Netherlands**	**Norway**	**UK**
Arab States	1.75	8.01	4.90	1.51
South and West Asia	1.81	5.82	7.35	8.32
Latin America and the Caribbean	1.37	4.95	2.57	2.62
Sub-Saharan Africa	1.06	4.22	6.07	8.61
East Asia and the Pacific (poorer countries)	1.06	6.84	6.42	2.91
Central Asia	3.81	0.73	0.35	0.35
East Asia and the Pacific (richer countries)	0.19	0.73	0.35	1.22
Central and Eastern Europe	24.23	14.26	16.80	9.83
North America and Western Europe	64.71	54.44	55.19	64.63
Total	100	100	100	100
Immigrant Population in the Country	**29.31 %**	**13.53 %**	**16.75 %**	**19.35 %**

Notes: The sample includes all individuals residing in each host country with non-missing region-of-birth information. Percentages show the distribution of immigrants by origin region within each country.

Language Skill and Labor Market Outcomes: Robustness Checks

Table OA2: Impact of Language Skill on Labor Market Outcomes for Second Generation Immigrants

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.194***	0.296	1.044***	1.562	9.269***	12.831	0.055**	-0.256
	(0.034)	(0.195)	(0.099)	(1.259)	(1.131)	(8.870)	(0.022)	(0.209)
Mean Outcome	2.84	2.84	5.77	5.77	46.74	46.74	3.55	3.55
1st Stage F-statistics	-	1.912	-	1.912	-	1.891	-	1.912
R-squared	0.675	0.658	0.618	0.601	0.515	0.498	0.483	0.127
Observations	722	722	722	722	716	716	722	722

Notes: The sample consists of second-generation immigrants with both parents born outside of the host country and currently aged 16 to 65 with non-missing wage, literacy score, age at arrival, years of schooling, region of birth and linguistic distance variables. Each regression includes age-at-arrival, region of birth, and host country dummies, along with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable Linguistic Distance to instrument the language skill. Standard errors are clustered at the birth region, host country, and early arrival level (in parentheses). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table OA3: Impact of Language Skill on Labor Market Outcomes Controlling for Highest Completed School Degree

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.096***	0.268***	0.509***	1.494***	4.698***	2.867	0.024	0.206*
	(0.026)	(0.102)	(0.152)	(0.578)	(1.003)	(6.047)	(0.026)	(0.125)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	13.93	-	13.93	-	14.02	-	13.93
R-squared	0.668	0.628	0.651	0.605	0.646	0.645	0.630	0.483
Observations	637	637	637	637	625	625	637	637

Notes: The sample consists of first-generation childhood immigrants who arrived in the host country by age 18, with both parents born outside the host country. It includes individuals aged 16–65 with non-missing values for wage, literacy score, age at arrival, years of schooling, region of birth, and linguistic distance. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy score using $\max(0, \text{age at arrival} - 11) \times \text{Linguistic Distance}$. Standard errors clustered at the birth-region, host-country, and early-arrival levels. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table OA4: Impact of Language Skill on Labor Market Outcomes Controlling Separately for Schooling at Origin and in Host Country

Dependent Variables	Years of Schooling		Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	1.539***	2.261***	0.084***	0.263**	0.399***	1.459**	5.683***	2.459	0.017	0.199
	(0.156)	(0.346)	(0.023)	(0.104)	(0.151)	(0.590)	(1.065)	(6.356)	(0.025)	(0.122)
Years of Schooling at sending country			0.018	-0.013	0.205***	0.020	2.693***	3.263***	0.007	-0.025
			(0.013)	(0.022)	(0.072)	(0.119)	(0.825)	(1.141)	(0.012)	(0.024)
Years of Schooling at host country			0.043***	0.011	0.365***	0.174	3.353***	3.933***	0.017*	-0.016
			(0.009)	(0.023)	(0.048)	(0.116)	(0.523)	(1.093)	(0.010)	(0.022)
Mean Outcome	11.90	11.90	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	19.97	-	12.42	-	12.42	-	12.57	-	12.42
R-squared	0.722	0.700	0.690	0.641	0.694	0.647	0.719	0.697	0.584	0.487
Observations	637	637	637	637	637	637	625	625	637	637

Notes: See Table OA3 for the sample. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Both years of schooling at home and host country are included. Standard errors clustered by birth region, host country, and early-arrival level.

Table OA5: Impact of Language Skill on Labor Market Outcomes controlling for Parental Education

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.141***	0.277***	0.880***	1.725***	10.110***	9.238**	0.039*	0.170**
	(0.026)	(0.067)	(0.145)	(0.399)	(0.948)	(4.205)	(0.021)	(0.085)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	19.81	-	19.81	-	20.07	-	19.81
R-squared	0.668	0.628	0.651	0.605	0.646	0.645	0.630	0.483
Observations	637	637	637	637	633	633	637	637

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Standard errors clustered by birth region, host country, and early-arrival level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table OA6: Impact of Language Skill on Labor Market Outcomes excluding Immigrants originating from North American and Western European Countries

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.146***	0.383***	0.929***	2.251***	10.655***	17.210***	0.056**	0.315***
	(0.029)	(0.104)	(0.172)	(0.721)	(1.272)	(4.560)	(0.026)	(0.102)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic		10.10		10.10		9.583		10.10
R-squared	0.693	0.580	0.685	0.581	0.694	0.651	0.641	0.440
Observations	503	503	503	503	493	493	503	503

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times \text{Linguistic Distance}$. Standard errors clustered by birth region, host country, and early-arrival level.

Table OA7: Impact of Language Skill on Labor Market Outcomes controlling for Year of Arrival

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.138***	0.315***	0.780***	1.444**	10.131***	8.545	0.022	0.264***
	(0.032)	(0.086)	(0.183)	(0.590)	(1.376)	(6.430)	(0.029)	(0.089)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	11.03	-	11.03	-	9.689	-	11.03
R-squared	0.731	0.684	0.720	0.700	0.697	0.695	0.628	0.477
Observations	574	574	574	574	563	563	574	574

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times \text{Linguistic Distance}$. Standard errors clustered by birth region, host country, and early-arrival level.

Table OA8: Impact of Language Skill on Labor Market Outcomes
(using 3 Instruments)

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.141***	0.220***	0.880***	1.110***	10.110***	9.857**	0.039*	0.168*
	(0.026)	(0.050)	(0.145)	(0.313)	(0.948)	(3.831)	(0.021)	(0.094)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	7.423	-	7.423	-	7.949	-	7.423
R-squared	0.668	0.655	0.651	0.647	0.646	0.646	0.578	0.522
Observations	637	637	637	637	625	625	637	637

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Standard errors clustered by birth region, host country, and early-arrival level.

Table OA9: Impact of Language Skill on Labor Market Outcomes
(Critical Age:10)

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige		Log Hours Worked	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.141***	0.277***	0.880***	1.641***	10.110***	8.646**	0.039*	0.184*
	(0.026)	(0.067)	(0.145)	(0.403)	(0.948)	(4.102)	(0.021)	(0.094)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
1st Stage F-statistic	-	16.28	-	16.28	-	16.35	-	16.28
R-squared	0.668	0.629	0.651	0.614	0.646	0.643	0.578	0.506
Observations	637	637	637	637	625	625	637	637

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Standard errors clustered by birth region, host country, and early-arrival level.

Table OA10: Impact of Language Skill on Labor Market Outcomes controlling for Cultural Distance (Secularism)

Dependent Variables	Log Hourly Wage		Wage Decile		Occ Prestige Score		Log Hours Worked	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Literacy Score	0.141***	0.284***	0.879***	1.768***	10.054***	9.116**	0.040*	0.174**
	(0.024)	(0.068)	(0.145)	(0.405)	(0.984)	(4.198)	(0.021)	(0.087)
Mean Outcome	2.80	2.80	4.93	4.93	40.18	40.18	3.54	3.54
Observations	637	637	637	637	625	625	637	637
R-squared	0.668	0.625	0.651	0.601	0.646	0.645	0.579	0.518
1st Stage F-statistic	-	21.38	-	21.38	-	21.23	-	21.38

Notes: See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Cultural distance is drawn from the World Values Survey and imputed at regional means for missing values. Standard errors clustered at the birth-region, host-country, and early-arrival levels.

Job Tasks: Robustness Checks

Table OA11: Impact of Language Skill on Task Requirement at Work (O*NET)

Dependent Variables	Analytical		Interactive		Manual	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy Score	0.791***	0.751**	1.069***	1.039**	-0.822***	-0.462
	(0.107)	(0.339)	(0.129)	(0.444)	(0.119)	(0.397)
Mean Outcome	0.07	0.07	0.66	0.66	0.27	0.27
1st Stage F-statistic	-	19.78	-	19.78	-	19.78
R-squared	0.607	0.606	0.617	0.617	0.617	0.602
Observations	625	625	625	625	625	625

See Table OA3 for the sample. Each regression includes age-at-arrival, region-of-birth, host-country, gender, and age–host-country interactions. The 2SLS estimate instruments literacy with $\max(0, \text{age at arrival} - 11) \times$ Linguistic Distance. Task indices follow Cassidy (2019) using O*NET. Analytical includes Mathematical Reasoning and Critical Thinking; Interactive includes Oral/Written Expression and Negotiation; Manual includes physical-strength measures. Standard errors clustered at the birth-region, host-country, and early-arrival levels.

Table OA12: Impact of Language Skill on Tasks Employed at Work controlling for Parental Education

Dependent Variables	Reading		Writing		Influence		Abstract		Physical Work	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	0.626***	0.739**	0.509***	0.202	0.437***	0.713*	0.585***	0.912***	-0.179***	-0.242**
	(0.088)	(0.350)	(0.093)	(0.290)	(0.071)	(0.371)	(0.063)	(0.315)	(0.024)	(0.102)
Mean Outcome	-0.06	-0.06	0.10	0.10	-0.18	-0.18	-0.25	-0.25	0.5	0.5
1st Stage F-statistic	-	19.81	-	19.81	-	20.07	-	19.81	-	19.81
R-squared	0.615	0.613	0.576	0.553	0.563	0.543	0.615	0.587	0.575	0.568
Observations	637	637	637	637	633	633	637	637	637	637

Notes: See notes for Table OA3 for the sample. Each regression includes age-at-arrival, region of birth, host country dummies with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable max (0, age at arrival − 11) × Linguistic Distance to instrument the language skill. Task variables are created using Principal Component Analysis. See notes for Table 5 for job task variables. Standard errors clustered at the birth region, host country and early arrival level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table OA13: Impact of Language Skill on Tasks Employed at Work excluding Immigrants originating from North American and Western European Countries

Dependent Variables	Reading		Writing		Influence		Abstract		Physical Work	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	0.700***	1.654***	0.529***	0.473	0.434***	0.760	0.598***	1.438**	-0.156***	-0.286**
	(0.103)	(0.556)	(0.118)	(0.392)	(0.096)	(0.637)	(0.088)	(0.570)	(0.032)	(0.113)
Mean Outcome	-0.06	-0.06	0.10	0.10	-0.18	-0.18	-0.25	-0.25	0.5	0.5
1st Stage F-statistic	-	10.10	-	10.10	-	10.08	-	10.10	-	10.10
R-squared	0.632	0.501	0.613	0.612	0.605	0.580	0.651	0.485	0.622	0.594
Observations	503	503	503	503	499	499	503	503	503	503

Notes: See notes for Table OA3 for the sample. Each regression includes age-at-arrival, region of birth, host country dummies with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable max (0, age at arrival − 11) × Linguistic Distance to instrument the language skill. Task variables are created using Principal Component Analysis. See notes for Table 5 for job task variables. Standard errors clustered at the birth region, host country and early arrival level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table OA14: Impact of Language Skill on Tasks Employed at Work
(Critical Age:10)

Dependent Variables	Reading		Writing		Influence		Abstract		Physical Work	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy Score	0.626***	0.658*	0.509***	0.223	0.437***	0.619*	0.574***	0.099	-0.179***	-0.276**
	(0.088)	(0.344)	(0.093)	(0.290)	(0.071)	(0.364)	(0.066)	(0.292)	(0.024)	(0.108)
Mean Outcome	-0.06	-0.06	0.10	0.10	-0.18	-0.18	-0.25	-0.25	0.5	0.5
(Std Dev)	(1.68)	(1.68)	(1.38)	(1.38)	(1.34)	(1.34)	(1.32)	(1.32)	(0.5)	(0.5)
1st Stage F-statistic	-	16.28	-	16.28	-	16.25	-	16.37	-	16.28
R-squared	0.615	0.615	0.576	0.556	0.563	0.554	0.621	0.548	0.575	0.558
Observations	637	637	637	637	633	633	634	634	637	637

Notes: See notes for Table OA3 for the sample. Each regression includes age-at-arrival, region of birth, host country dummies with a gender dummy and age interacted with host country dummies. The 2SLS estimate is obtained using the variable max (0, age at arrival – 11) × Linguistic Distance to instrument the language skill. Task variables are created using Principal Component Analysis. See notes for Table 5 for job task variables. Standard errors clustered at the birth region, host country and early arrival level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Qualification Mismatch: Robustness Checks

Table OA15: Impact of Language Skill on Qualification Mismatch
controlling for Parental Education

Dependent Variables	Over-qualified		Well-qualified		Under-qualified	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy Score	0.030	-0.127*	0.079**	0.469***	-0.109***	-0.341***
	(0.019)	(0.065)	(0.032)	(0.143)	(0.026)	(0.111)
Mean Outcome	0.07	0.07	0.66	0.66	0.27	0.27
1st Stage F-statistic	-	19.81	-	19.81	-	19.81
R-squared	0.435	0.254	0.484	0.171	0.546	0.419
Observations	637	637	637	637	637	637

Notes: See Table OA3 for the sample. Over-, well-, and under-qualified dummies defined relative to occupation-specific schooling ranges. Instrument and clustering identical to earlier tables.

Table OA16: Impact of Language Skill on Qualification Mismatch (Median)

Dependent Variables	Over-qualified		Well-qualified		Under-qualified	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy Score	0.032	-0.119*	0.050	0.416***	-0.082**	-0.297***
	(0.025)	(0.067)	(0.031)	(0.141)	(0.033)	(0.112)
Mean Outcome	0.07	0.07	0.66	0.66	0.27	0.27
1st Stage F-statistic	-	19.81	-	19.81	-	19.81
R-squared	0.463	0.337	0.466	0.205	0.517	0.413
Observations	637	637	637	637	637	637

Notes: Sample is the same as Table OA15, but qualification range based on median years of schooling within occupation.

Table OA17: Impact of Language Skill on Qualification Mismatch (Mode)

Dependent Variables	Over-qualified		Well-qualified		Under-qualified	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Literacy Score	0.025	-0.058	0.038	0.336**	-0.063**	-0.277**
	(0.019)	(0.094)	(0.031)	(0.156)	(0.031)	(0.108)
Mean Outcome	0.07	0.07	0.66	0.66	0.27	0.27
1st Stage F-statistic	-	19.81	-	19.81	-	19.81
R-squared	0.472	0.433	0.462	0.293	0.500	0.402
Observations	637	637	637	637	637	637

Notes: Sample is the same as Table OA15, but qualification range based on modal years of schooling within occupation.