Age at Arrival and Life Chances Among Childhood Immigrants

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Abstract This study examines the causal relationship between childhood immigrants' age at arrival and their life chances as adults. I analyze panel data on siblings from Norwegian administrative registries, which enables me to disentangle the effect of age at arrival on adult socioeconomic outcomes from all fixed family-level conditions and endowments shared by siblings. Findings from sibling fixed-effects models reveal a progressively stronger adverse influence of immigration at later stages of childhood on completed education, employment, adult earnings, occupational attainment, and social welfare assistance. The persistence of these relationships within families indicates that experiences related to the timing of childhood immigration have causal effects on later-life outcomes. These age-at-arrival effects are considerably stronger among children who arrive from geographically distant and economically less-developed origin regions than among children originating from developed countries. The age-at-arrival effects vary less by parental education and child gender. On the whole, the findings indicate that childhood immigration after an early-life formative period tends to constrain later human capital formation and economic opportunities over the life course.

Keywords Age at arrival; Immigration; Assimilation; Ethnic stratification; Sibling fixed effects

Introduction

To what extent does immigration at different stages of development in childhood and adolescence structure children's chances of getting ahead later in life? Recent estimates from the United Nations indicated that approximately 16 % of the total stock of international migrants—approximately 33 million individuals—are younger than age 20, and that approximately two-thirds of these immigrant youth are older than age 10 (United Nations 2012). Moreover, adolescents and young adults constitute more than one-third of the current flow of international migrants (McKenzie 2008). Thus, persons who immigrated during early stages of their lives constitute a growing share of the future workforce in rich, developed societies. A better understanding of whether the life cycle timing of childhood immigration has enduring effects on adult outcomes is therefore crucial for future policies aimed at incorporating these young newcomers as full-fledged and productive members in their host societies.

To highlight the challenges faced by childhood immigrants, researchers have labeled them the "1.5 immigrant generation" to differentiate their experiences from those of (first-generation) immigrants arriving as adults and their native-born children in the second generation (Oropesa and Landale 1997; Rumbaut 2004). To be more specific, age at arrival clearly demarcates the life cycle stage at which immigrants start life in a new country. Thus, age at arrival is important because, as Piore (1979:65–66) pointed out, "in relation to individual attitudes and behavior, the critical distinction appears not be the place of birth but the place where one grows up and, in particular, spends his or her adolescence." Focus on age at arrival offers a bridging perspective to understand the processes that shape variation in socioeconomic assimilation and how these gradients emerge across immigrant generations.

Adopting a life-course framework, in which the timing of events over the lifespan is viewed as an important turning point for later developmental trajectories (Elder 1998; Mayer 2009), the aim of the present study is to investigate whether the experience of childhood immigration affect future life chances in different ways, depending on when this event occurs. In particular, I seek to examine (1) whether age at arrival has a causal impact on completed education and adult labor market outcomes, and (2) how the impact of childhood immigration varies according to children's age at arrival.

This article presents new empirical evidence on the causal relationship between childhood immigrants' age at arrival and their adult socioeconomic attainments. I draw on high-quality data from Norwegian administrative registries, which enables the linkage of information on children's age at arrival, spanning their whole childhood, to their subsequent educational attainment and a broad range of adult labor market outcomes (i.e., employment, adult earnings, occupational attainment, and social welfare assistance). The sibling panel structure of these data also allows me to use fixed-effects methods to control for the effects of all stable characteristics shared by siblings while growing up, which provides enhanced confidence in a causal interpretation of the estimates. The key question is whether the effect of age at arrival is robust to inclusion of these family-specific fixed effects.

The results reveal a progressively more negative relationship between children's age at arrival and adult outcomes, indicating that the experience of immigration at later stages of childhood development leaves a lasting impact on children's later-life outcomes. Further, the impact of arrival at older ages is considerably stronger among childhood immigrants arriving from geographically distant and economically less-developed origin countries, but less variation exists by child gender and parental education. Before moving to the empirical research, I discuss theoretical arguments about why age at arrival should matter for childhood immigrants' later-life outcomes, previous research, and the Norwegian setting.

Background Literature

A large body of evidence has documented how experiences during formative periods early in life exhibit lasting influences on adult outcomes. This literature highlights the age-linked and hierarchical character of human development, where acquisition of a wide range of cognitive and socioemotional capacities progresses through sensitive periods of optimal learning, after which developmental plasticity becomes gradually more constrained (Knudsen et al. 2006; Shonkoff and Phillips 2000). A key implication is that learning deficiencies emerging at early stages of the life cycle shape later skill formation, which may translate into cumulative disadvantages in recursive patterns as children age into adulthood (Cunha et al. 2006).

From such a life-course perspective, several reasons suggest that the timing of immigration at different childhood stages may influence children's developmental trajectories. To begin, it is a stylized fact that younger children learn new languages with greater ease and success than adolescents and adults. The sensitive period of language development refers to an early childhood period when the capacity to acquire full proficiency in new languages is at its prime, prior to maturational changes in the brain in the years before onset of puberty (Lenneberg 1967; Penfield and Roberts 1959). Newport (2002) suggested that declines in acquisition of a second language could begin as early as ages 4–6.[1] Although some work has disputed the sensitive period hypothesis (e.g., Hakuta et al. 2003), the consensus in the cognitive psychology literature appears to be that attainment of a second language is negatively correlated with age of first exposure (Birdsong 2006; Newport 2002).

For childhood immigrants, acquisition of fluency in the host-country language is likely to be important for their labor market careers. Language skills constitute a basic form of

[1] The senstive period of language acquisition appears to primarily affect the formal aspects of language, such as phonology, morphology, and syntax, but not the processing of meaning, such as aqcuisition of vocabulary and semantic understanding (Newport 2002).

human capital in the sense that without sufficient competence, other skills become irrelevant (Chiswick and Miller 1992).[2] Language-related barriers may also affect human capital accumulation more directly in schools, through less-efficient subject-specific learning while trying to master a new language. The sensitive period hypothesis predicts that early-arriving childhood immigrants will easily acquire native-level language proficiency, whereas later-arriving children experience accentuating difficulties, with adolescent arrivals at particular risk.

Developmental theories of identity formation have also suggested that age at arrival could affect socioeconomic attainment through pathways related to acculturation and social assimilation (Erikson 1968). Whereas early childhood is characterized by intense dependence needs and confinement to the home environment, middle childhood and adolescence are characterized by the development of self-concepts, growing independence from parents, and the need to fit in with peer groups outside the family (Eccles et al. 1993; Steinberg and Silverberg 1986). Children also develop a stronger sense of ethnic awareness throughout later stages of childhood, especially during adolescence (Berry et al. 2006; Phinney 1990). For children having experienced formative early-childhood socialization in the country of origin, migration and the need to start life over again in a new country may be disruptive for their social development (Coll and Magnuson 1997; Suarez-Orozco and Suárez-Orozco 2001). If childhood immigrants experience exclusion by native peers in schools and difficulties with fitting in at this crucial stage in life, they may develop oppositional self-identities and a reactive orientation toward their ethnic origin (Rumbaut 1994). Adolescent immigrants must also balance the often conflicting expectations of their immigrant parents and the host societal

[2] Numerous studies have reported a positive relationship between language skills and labor market outcomes (e.g., Dustmann and Soest 2002; Kossoudji 1988; McManus et al. 1983; Tainer 1988).

setting as they maneuver their path into adulthood (Fuligni 2001). The psychological costs of adjusting in the new country may therefore be higher for later-arriving children, possibly resulting in dissonant acculturation and adverse socioeconomic outcomes (Portes and Rumbaut 2001).

Immigration at later childhood stages may further augment disparities through less exposure to improved educational opportunities and better learning environments in host country schools. For example, immigration after school-starting age implies that children miss any benefits associated with attending preschool in their host country, while children arriving after primary school often miss out on intensive instruction in numeracy and literacy provided in these grades. Further, older ages at immigration implies less time for children and their parents to acclimate to formal and informal rules in the school system before consequential educational decisions must be made. Childhood immigrants' difficulties in school are therefore likely to be aggravated not only by greater linguistic and cultural dissimilarities but also by differences in educational standards and the broader institutional setting between children's origin countries and the receiving context (Cobb-Clark et al. 2012; Heath and Kilpi-Jakonen 2012). In some cases, adolescent immigrants also enter the labor market directly without ever attending school in the host society (Oropesa and Landale 2009). Furthermore, foreign-born children who received most of their schooling in less-developed contexts are also likely to face labor market disadvantages because of low economic returns to skills and qualifications acquired prior to migration (Bratsberg and Ragan Jr. 2002; Friedberg 2000).

These arguments suggest that the impact of age at arrival is likely to be stronger among children immigrating to rich, developed host societies in the West from geographically and culturally more distant and less–economically developed world regions. However, effects may also differ by parental education and child gender. With respect to parental education,

high-skilled parents may have been able to provide their children with better opportunities prior to migration while also lessening the impact of transition to a new societal context by more quickly assimilating into the host society (Portes and Rumbaut 2001). Thus, resource compensation among highly educated immigrant parents might dampen the negative role of later immigration on their children's adult outcomes compared with children of less-skilled parents. Moreover, traditional gender values regarding educational investment and labor market participation cause girls to remain strongly disadvantaged in education in many less-developed world regions (Grant and Behrman 2010; Wils and Goujon 1998). If early childhood immigration to the destination country or being a native-born member of the second generation is consequential for improved female success in education and subsequent adult labor market outcomes (e.g., Fleischmann et al. 2014), we may expect stronger negative effects of age at arrival among girls compared with boys.

To summarize, these perspectives suggest that immigration could become a decisive turning point in children's lives and that the timing of this event may impose path-dependent developmental constraints on their subsequent human capital accumulation and labor market opportunities. Yet, the extent to which age at arrival affects childhood immigrants' adult outcomes is, of course, a matter for empirical investigation. Cross-sectional studies have reported age-related declines in adult socioeconomic outcomes among children immigrating to Canada (Corak 2012; Lee and Edmonston 2011; Schaafsma and Sweetman 2001), the Netherlands (Van Ours and Veenman 2006), Germany (Söhn 2011), Sweden (Böhlmark 2009), and the United States (Chiswick and DebBurman 2004; Gonzalez 2003; Lee and Edmonston 2011; Myers et al. 2009). These gradients seem well established, but some controversy exists related to whether they reflect a discontinuous sensitive period of early skill formation. For example, Chiswick and DebBurman (2004:375) reported that early-arriving childhood immigrants complete more schooling than native-born children, but they

also found steady declines after immigration at age 5, and "[I]mmigration in the teenage years (ages 13–19) appears to convey the greatest disadvantage." Looking at a broad range of socioeconomic outcomes among Mexican immigrants to the United States, Myers et al. (2009:205) found clear gradients of age-at-arrival effects, but "little evidence at any age of a sharp discontinuity demarcating a 1.5 generation from older immigrants and, in fact, a series of classifications or a continuous measurement of age at arrival may be preferred in some cases."

Several studies have also used instrumental variable (IV) techniques to partial out the language-related effects of childhood immigration to Anglophone countries by comparing age-at-arrival gradients in the outcomes among children arriving from other Anglophone countries with those of childhood immigrants originating from countries where English language is less widely used (Beck et al. 2012; Bleakley and Chin 2004, 2010; Guven and Islam 2015; Wang and Wang 2011).[3] These studies provide compelling evidence that age at arrival and its effect on language-related skills have a lasting impact on educational attainment, adult earnings, and a variety of social assimilation outcomes among children with limited exposure to English before migration.

Despite important contributions, concern remains as to whether the estimated relationships between age at arrival and later-life outcomes are causal. Migration theories have explicated the selectivity of migration (Massey et al. 1993), and empirical research has documented how immigrants to a varying degree are either positively or negatively selected on traits such as education and health relative to nonmigrants in the country of origin (Akresh

[3] Identification of language-related effects of age at arrival rests on the assumption that all other age-at-arrival effects (i.e., those not related to language acquisition) are shared by children arriving in the host society (i.e., the United States and Australia) from Anglophone and non-Anglophone origin countries.

and Frank 2008; Feliciano 2005; Lessard-Phillips et al. 2014). If unobserved heterogeneity exists between children (and their families) who immigrate at different developmental stages, this endogeneity makes it is difficult to separate the causal age-at-arrival effect from the effects of these correlated factors. For example, migrant parents concerned with their children's well-being may choose to migrate when children are younger; others, such as refugees and asylum seekers, may have limited opportunities to take their children's age into account when deciding the timing of migration. Sibling comparisons offer a way to adjust for selective timing of childhood immigration and bias from related family-level characteristics shared by siblings.

To date, previous studies with sibling comparison designs have focused on the relationship between childhood immigrants' age at arrival and their academic achievement, completion of upper-secondary education, and social assimilation (Åslund et al. 2015; Böhlmark 2008; Bratsberg et al. 2012). Using a sibling comparison design, the present study contributes by assessing the impact of age at arrival on educational attainment and a broad set of indicators of economic well-being in adulthood.

Institutional Setting and Immigration to Norway

The empirical analysis focuses on childhood immigrants arriving in Norway from the late 1960s and onward to year 2000, which provides an interesting host-societal setting because of the combination of a diverse immigrant population and the presence of strong welfare state institutions. Norway provides generous social welfare programs to all legal residents on a universal basis (Esping-Andersen 1999). Upon arrival, immigrants and their children are eligible for high-quality basic services, such as full coverage in health care services, access to subsidized early childhood education, free primary through university education, and other social security benefits important for child well-being. Norway has consistently ranked in the very top of the United Nations Development Program (UNDP) Human Development Index

over the past decades (UNDP 2011), and has comparatively low economic inequality (OECD 2008) as well as a low prevalence of child poverty (UNICEF 2016). Summarized across a large number of domains, Norway is one of the most child-friendly countries in Europe (Bradshaw and Richardson 2009). Taken together, children from less-developed world regions who immigrate to Norway at older ages will increasingly miss out on advantages related to improved standards of living, educational opportunities, and other factors that foster socioeconomic progress in the egalitarian Norwegian welfare state.

Norway is representative of Europe's increasingly ethnically diverse host societies (Dustmann and Frattini 2013; OECD 2015). Between 1970 and 2016, the share of immigrants and their native-born children in the resident population grew from 1.5 % to 16 %, with most of this growth reflecting inflow from less-developed world regions (Statistics Norway 2016). Non-European immigration began around 1970 and comprised young, unskilled, male labor migrants from Pakistan, Turkey, and Morocco.[4] In 1975, a moratorium on unskilled labor immigration was introduced. Later adopted as a permanent measure, this legislation ended unskilled labor immigration from less-developed countries but allowed for immigration according to three main principles: (1) demand for specific skilled labor; (2) entry of refugees and political asylum seekers granted protection on humanitarian reasons; and (3) family-based immigration for kin of immigrants already in Norway (i.e., either through reunification with existing family members or as family formation through entry into marriage with a foreign-born spouse, typically found in the same origin country) (Brochmann and Kjeldstadli 2008).

After 1975, admission to Norway from outside Western Europe was primarily confined to immigration due to humanitarian principles and family-based immigration (i.e.,

[4] Prior to 1970, immigration to Norway primarily consisted of citizens from the Nordic countries and other Western Europeans who came to seek work or who immigrated because of family connections.

for the kin of original migrant workers or humanitarian immigrants). Starting in the late 1970s, the number of refugees and asylum seekers arriving from recent conflict areas—such as Vietnam, Chile, Sri Lanka, and Iran (1980s), the Balkans (early 1990s), and Iraq and Somalia (late 1990s)—grew substantially. Although post-1975 labor immigration from less-developed countries was negligible, the ethnic minorities that initially consisted of the early cohorts of migrant workers kept growing because of family-based chain migration. As a consequence, the Pakistani-origin group had become the largest origin group in the Norwegian immigrant population by year 2000 (Brochmann and Kjeldstadli 2008).

Regardless of entry criteria, most immigrant groups arriving from less-developed countries experienced declining employment rates and increasing dependency on social welfare assistance over the life cycle. Prior research has suggested that universal access to social welfare assistance created work disincentives that contributed to declining life cycle employment among low-skilled immigrants with many dependent family members (Bratsberg et al. 2010, 2014). Despite generous welfare provisions, children of non-European immigrants faced markedly higher risks of exposure to childhood poverty compared with children of native Norwegians (Galloway et al. 2015). Yet, second-generation immigrants, born in Norway, experienced considerable intergenerational convergence toward native-level attainments in education and labor market outcomes (Bratsberg et al. 2012, 2014; Hermansen 2016).

Data and Variable Definitions

I use data from administrative records covering the entire population of native-born and foreign-born residents in Norway. A system of unique individual identifiers enables merging information from several official registries as well as matching parents with their children, which also facilitates proper identification of siblings. Through the unique child identifier, demographic family information is merged with information on completed education and

employment-related outcomes in the period 1993 to 2012. Official administrative registries also collect information on individual's country of birth and, if foreign-born, the date of the first registered entry into Norway, which permits the analysis of age at arrival, the key purpose of this study. Merging this information with data on adult outcomes enables me to relate each child's age at arrival, spanning the whole childhood, to later-life socioeconomic outcomes.

The data are drawn from the entire population of children who were born in the period 1963–1982 and current residents in Norway in 2012. This sample consists of more than 1.2 million individuals, spanning 20 birth cohorts. I restrict this sample to persons with two foreign-born parents, which constitute approximately 9 % of the aforementioned population. Furthermore, all persons who immigrated into Norway after age 18 are excluded. Persons without registered information on educational qualification level—constituting about 3.4 % of the remaining sample—are excluded. The final sample results in 29,405 children with two foreign-born parents, who were either born in Norway or who were up to age 18 years at arrival. Within the full sample, 5,844 children were born in Norway, and 23,561 were born abroad. Finally, I obtain the sibling sample by selecting children from immigrant families with at least two siblings, thus satisfying the aforementioned criteria. The sibling sample consists of 17,372 children in 6,588 families, 4,449 of whom were born in Norway and 12,923 of whom were born abroad. Table 1 provides summary statistics on key variables used in the analyses for both samples.

< Table 1 >

Age at Arrival

The key explanatory variable measuring children's age at arrival is constructed from records in the Central Population Registry, which holds information on each child's nativity, date of birth, and (if born abroad) date of the first stay in Norway. This information is recorded when

a child is given a personal identifier in the Central Population Registry.[5] For the foreign-born, I then construct indicators of age at arrival, defined as the difference between each childhood migrant's year of immigration and birth year. As noted earlier, the sample is restricted to children born in Norway or who arrived up to age 18. For these children, the timing of immigration is less likely to be subject to individual choice, and they are more likely to have followed their parents when they decided to migrate. Because age at arrival is defined as the difference between year of immigration and birth year, the variable will capture the combined variation in age at arrival and length of residency (in years) among individuals within each birth cohort. However, all adult outcomes are measured at age 30 and onward, which implies that the minimum length of residency is 12 years for the oldest arriving individuals. Given the length of the period spent in Norway, it seems plausible that the estimated age-at-arrival effects reflect stable differences in socioeconomic outcomes between children arriving at different ages rather than transitory effects of ongoing assimilation processes related to length of residency.

Adult Socioeconomic Outcomes

Educational attainment measures the highest level of educational qualification at age 30 using the Norwegian version of ISCED-97 (Statistics Norway 2001). Educational qualification levels are then transformed to years of completed education.

Adult earnings are based on tax reports of annual earnings, in fixed prices, and are measured with high accuracy. Earnings in Norwegian kroner (NOK) are inflated to 2012 levels using the Norwegian consumer price index (CPI) and are converted to U.S. dollars

[5] Norwegian registry-based data on year of arrival are based on the first registered stay in official statistics, whereas census or survey data used in similar studies from Australia, Canada, and the United States often rely on self-reported information by immigrants on when they first arrived, arrived for the current stay, or simply arrived (Redstone and Massey 2003).

using the purchasing power parity exchange rate for 2012—9.03 NOK per U.S. dollar—obtained from the Organisation for Economic Co-operation and Development (OECD). To measure earnings and labor market attachment, I then rely on the basic amount thresholds of the Norwegian Social Insurance Scheme (used to define labor market status, determining eligibility for unemployment benefits as well as disability and old age pension). In 2012, basic amount threshold was about U.S. $9,100.[6] Adult earnings are gleaned from all available tax reports on wages and income from self-employment in the period when the child was aged 30–34 years, and are calculated by taking the mean of all yearly observations in this period. I then take the natural logarithm of annual earnings. Because dropping individuals with zero earnings may conceal important treatment effects, including the whole earnings distribution in the analysis is important. To include individuals with zero earnings, I report results using two outcomes to differentiate between employment effects and variation in annual earnings among those with stable employment: (1) a dichotomous proxy indicator for stable employment if an individual has average annual earnings that exceed twice the basic amount (1 = yes, 0 = no); and (2) log-earnings above the same cutoff point (i.e., earnings conditional on stable employment). To include the full earnings distribution in one measure, I also rank children based on their earnings relative to all other persons in the same birth cohort (i.e., using the entire native and immigrant-origin population), irrespective of gender and including those with zero earnings. This yields a symmetric variable that captures earnings rank measured as the cohort-specific percentile in the overall earnings distribution, which ranges from 0 (lowest) to 100 (highest). Further, I also include a dichotomous indicator of social welfare assistance if the annual sum of public cash transfers and unemployment benefits a person received in this period on average was above one basic amount (1 = yes, 0 = no).

[6] For the calculation of stable employment, the basic amount is doubled and would equal approximately U.S. $18,200.

Occupational attainment is captured using a dichotomous indicator of whether the individual ever held a professional/managerial occupation within the service class, using the Erikson-Goldthorpe-Portocarero (EGP) class schema (Erikson and Goldthorpe 1992) when the child was aged 30 years or older (1 = yes, 0 = no). These professional/managerial occupations (EGP I and II) include managers and government officials, the classical professions (e.g., jurists, health professionals), and other professions (e.g., teachers and nonmedical technicians). Occupational information is taken from the Employer and Employee registry, in which employers annually are required to file occupational titles on all employees to the Norwegian Labor and Welfare Service (NAV); this occupational information was then coded using the Norwegian version of ISCO-88 (Statistics Norway 1998).[7]

Sociodemographic Background Characteristics

I include several child-specific covariates: child gender, whether the child was the firstborn child of his or her mother, and dummy indicators of birth cohort. In cross-sectional model specifications, I also adjust for observed family-specific information on parental education and country of origin. The educational attainment of the parents refers to the parent with the highest formal educational qualification when the child was 16 years old. In subgroup analyses, I differentiate between children in academic families (i.e., at least one parent has completed academic upper-secondary education or a higher attainment level) and nonacademic families (i.e., no parent has completed academic upper-secondary education).The child's country of origin refers to his or her mother's country of birth, regardless of the child's country of birth. Children represent 155 different nationalities in the full sample. In subgroup analyses, I differentiate between five different regions of origin: (1) West, (2) Eastern Europe, (3) Asia, (4) Middle East and Greater Arabia, and (5) Africa and

[7] This information is available only from 2003. From this year onward, I use information on all annual observations when the child is 30 years or older.

South America (see Table 7 of the appendix for a detailed list of the major origin countries within each region).[8]

Empirical Analysis

The aim of the empirical analysis is to estimate the causal effect of age at arrival on children's adult socioeconomic outcomes. The key challenge is concern for selective immigration related to children's age at arrival and bias from related sources of unobserved heterogeneity in family-level characteristics. To handle this issue, I estimate sibling fixed-effects models that rely on within-family variation to disentangle the effect of children's age at arrival from all other fixed characteristics shared by siblings while growing up. The advantages of using the sibling comparison strategy can be demonstrated by first considering the following linear model:

$$Y_{ij} = \beta \mathbf{A}_{ij} + \gamma \mathbf{X}_{ij} + \delta \mathbf{Z}_j + \mu_j + \varepsilon_{ij}, \quad (1)$$

where Y_{ij} refers to the relevant socioeconomic outcome of child *i* in family *j*. This outcome is a function of indicators of age at arrival, $\mathbf{A}_{ij}$; a vector of child-specific variables, $\mathbf{X}_{ij}$, that vary within families; and a vector of family-specific variables, $\mathbf{Z}_j$, that do not vary within families. The error term has a family-specific component, μ_j, which reflects omitted characteristics that do not vary between siblings, and an individual-specific component, ε_{ij}. To the extent that age at arrival, $\mathbf{A}_{ij}$, is correlated with unobserved family characteristics (μ_j), the estimates of β may be biased.

Estimation of sibling fixed-effects models takes advantage of information present in panel data on siblings within families to eliminate this bias by subtracting each variable from its corresponding family mean:

$$y_{ij} - \bar{y}_j = \beta\left(\mathbf{A}_{ij} - \bar{\mathbf{A}}_j\right) + \gamma\left(\mathbf{X}_{ij} - \bar{\mathbf{X}}_j\right) + \delta\left(\mathbf{Z}_j - \bar{\mathbf{Z}}_j\right) + \left(\mu_j - \bar{\mu}_j\right) + \left(\varepsilon_{ij} - \bar{\varepsilon}_j\right), \quad (2)$$

[8] Because of few observations, the South American and African origin regions were merged.

which reduces to

$$y_{ij} - \bar{y}_j = \beta(\mathbf{A}_{ij} - \bar{\mathbf{A}}_j) + \gamma(\mathbf{X}_{ij} - \bar{\mathbf{X}}_j) + (\varepsilon_{ij} - \bar{\varepsilon}_j), \quad (3)$$

and this can then be rewritten as

$$\Delta y_i = \beta \Delta \mathbf{A}_i + \gamma \Delta \mathbf{X}_i + \Delta \varepsilon_i, \quad (4)$$

where the increment Δ indicates difference scores. Eq. (4) demonstrates the main strength of the within-family estimator, which implies that the estimated effect of age at arrival, β, is obtained after removing confounding from all fixed characteristics that are shared by siblings.

The identifying assumption is that siblings on average are expected to fare equally well in the absence of different ages at arrival. Although sibling fixed-effect models can eliminate bias attributable to unobserved family-specific heterogeneity, potential bias attributable to unobserved heterogeneities that are not shared by siblings remains. However, I include child-specific characteristics that may cause siblings within the same family to experience the family environment differently. These variables include child gender, whether the child was the firstborn of his or her mother, and birth cohort. I adjust for birth cohort in order to take into account secular changes in educational attainment across birth cohorts, as well as business cycles and real earnings growth over time. Effects of unobserved child-specific characteristics, such as child ability and health, are not captured. However, child-specific unobserved heterogeneity will not bias the estimates as long it is not systematically related to between-sibling variation in age at arrival. Thus, premigration differences in siblings' abilities, health, and other unobserved characteristics will not bias the estimates if they are not systematically related to age at arrival. Further, it is not desirable to adjust for time-varying family characteristics arising after arrival, reflecting parents' length of residency and improved assimilation, because they reflect the process of adjustment and should be included in the estimated age-at-arrival effects.

Results

Table 2 presents children's mean socioeconomic outcomes by age at arrival. Norwegian-born children of immigrants fare better in education and the labor market compared to foreign-born children arriving at different childhood stages, and the patterns are similar in both samples. Comparing childhood periods, we see a gradual decline in educational attainment at older ages at arrival and children who arrive during adolescence complete slightly more than one year less education compared to Norwegian-born immigrant offspring. Turning to labor market outcomes, a similar pattern is revealed. Adolescent immigrants earn, on average, almost U.S. $9,000 less per year as adults compared to their Norwegian-born counterparts. This gap is equivalent to an almost 9 percentile drop in the rank order position in the overall earnings distribution. Moreover, the corresponding likelihood of not being in stable employment and being on social welfare is approximately 9 and 11 percentage points higher, respectively. Although approximately 50 % of the native-born children are found in professional/managerial occupations, this figure hovers near only 28 % among adolescent immigrants. These results show a clear gradient of declining educational and economic success among later-arriving childhood immigrants.

< Table 2 >

Semiparametric Estimates of Age-at-Arrival Effects on Adult Socieconomic Outcomes

The next task is to estimate the causal relationship between age at arrival and children's adult socioeconomic achievements. The panels in Fig. 1 summarize the results from a set of linear regressions predicting children's educational attainment and adult labor market outcomes (years of education, employment, log earnings, earnings rank, professional/managerial occupation, and social welfare assistance) by age at arrival. In all specifications, age at arrival is entered as a set of dummy variables indicating children's arrival ages in two-year intervals. This semiparametric specification allows for a flexible relationship between children's adult outcomes and age at arrival. The estimated socioeconomic gradients by childhood immigrants'

age at arrival are plotted relative to the outcomes of children of immigrants born in Norway, as indicated by the horizontal solid line at 0 in each panel. My main interest lies in the preferred within-family estimates from the sibling fixed-effects specification controlling for the child-specific covariates. For comparison, I also present the estimates from the cross-sectional OLS specification for both the full sample and the sibling sample where I also control for parental education and a set of dummy indicators for country of origin. For the binary outcomes, I report marginal effects (probability changes) estimated using linear probability models. In these models, the probability of the given outcome ($y = 1$) is assumed to be a linear function of the set of predictors (Wooldridge 2010).

-- Figure 1 --

Figure 1 reveals several key findings. First, these patterns provide strong evidence that older age at arrival has a negative and long-term impact on educational attainment and labor market success and that this effect is robust to controls for all stable between-family heterogeneity factored out by the sibling fixed effects. This finding strengthens the assertion that an older age at arrival among childhood immigrants is causally related to more adverse outcomes in terms of human capital accumulation and adult economic success. Although socioeconomic disadvantages among childhood immigrants emerge among those arriving before school age, the gaps relative to Norwegian-born children grow progressively larger among those arriving at later stages of childhood. For all outcomes, the strongest negative effects are found among those who immigrate as adolescents.

Second, the age-at-arrival gradients estimated using different model specifcations and samples are broadly comparable for most outcomes. Although the estimated within-family gradients by age at arrival are less steep than the cross-sectional estimates for educational attainment and employment, the overall pattern is similar. For most labor market outcomes, results obtained from the cross-sectional ordinary least squares (OLS) models closely

resemble those from the sibling fixed-effects models. Furthermore, high resemblance between the cross-sectional estimates for the sibling sample and the total sample also provides some leverage to claim that the within-family results obtained from the sibling sample are valid also for the full sample.

Table 3 provides more detailed information on the regression estimates reported for the sibling sample.[9] The preferred sibling fixed-effects coefficients show that immigration during adolescence (ages 13–18) is associated with 0.4 to 0.8 fewer years of completed education compared with Norwegian-born children. Children arriving at older ages also experience substantial disparities in adult economic welfare. Although the age-at-arrival gradient in employment within families is relatively weak and does not reach significance at conventional levels, the estimated impact of age at arrival on the annual earnings is substantial. The log earnings estimates suggest that conditional on employment, adolescent arrivals earn between 13 % and 20 % less annually compared with native-born children.[10] Looking at relative earnings positions, immigration during the adolescent years is associated with a 6 to 8 percentile drop in children's adult earnings rank. Moreover, the likelihood of holding a professional/managerial occupational position is lowered by 18–26 percentage points among those who arrived during adolescence. Finally, the probability of receiving social welfare transfers is also heightened by 8–12 percentage points for adolescent immigrants.

< Table 3 >

To summarize, the results demonstrate how children's life chances become increasingly more constrained by immigrating at later developmental stages. Although these

[9] Full regression estimates for the full sample are available upon request.

[10] These calculations use the exp(β) – 1 formula. Note also that for the analysis of log earnings conditional on employment, the sibling sample is further limited to persons in families where at least two siblings were above the employment cut-off.

negative effects grow progressively stronger at older ages, I do not find clear evidence of any abrupt turning points in the effect but rather a pattern of gradual decline.

Spline Estimates of Stage-Specific Effects of Age at Arrival

The next task is to more directly assess whether the effect of age at arrival follows a nonlinear pattern in which the impact of age at arrival is progressively stronger among those arriving in later childhood. Table 4 addresses this issue by reporting estimates from sibling fixed-effect regressions using different functional-form specifications of age at arrival. Panel A shows the effect of age at arrival estimated using a continuous specification, which constrains the estimated effect of age at arrival to be linear throughout childhood (i.e., ages 0–18). Panel B shows estimated three stage-specific piecewise linear spline segments (Marsh and Cormier 2002), which allow the age-at-arrival effects to vary across early childhood (i.e., ages 0–6), middle childhood (i.e., ages 7–12), and adolescence (i.e., ages 13–18). The coefficients in both panels refer to the linear effect of one-year increments to age at arrival, either averaged across childhood or specific to each childhood period. If the age-at-arrival effect does not vary by childhood period, the three coefficients should be roughly the same size as the linear whole-childhood coefficient. Thus, the stage-specific spline specification enables evaluation of whether the age-at-arrival slopes vary among children arriving at different chilhood periods. I also report tests of differences between the stage-specific age-at-arrival slopes.

< Table 4 >

Table 4 shows increasingly more detrimental age-at-arrival effects in later childhood stages. The strongest age-at-arrival effects are found for arrival during adolescence, but the splines for early-childhood and middle-childhood immigration indicate gradually weaker effects of arrival at earlier chilhood stages. For educational attainment, we see a clear pattern of stronger effects for arrival during adolescence, and tests of difference show signficant differences in the effect of immigrating during early childhood relative adolescence (p = .003).

Turning to labor market outcomes, a nonlinear pattern is less clear for employment and earnings rank. However, the estimated age-at-arrival effects on log earnings (conditional on employment) and the likelihood of being in a professional/managerial occupation are progressively stronger for each childhood period. Differences in the estimated effect of arrival in early childhood versus adolescence are also significant for both log earnings (p = .087) and occupational attainment (p = .001). Finally, the effect of age at arrival on social welfare assistance is stronger during adolescence than during early childhood (p = .119). Taken together, these findings suggest a progressively stronger impact of age at arrival at later stages of childhood on a broad range of adult outcomes.

The Role of Education for Age-at-Arrival Effects on Adult Labor Market Outcomes

Given the observed patterns, I next attempt to disentangle whether the declining economic success among childhood immigrants arriving at older ages reflects their lower educational attainment. Prior studies have found that a substantial part of the link between age at arrival and adult earnings reflects differences in the amount of education immigrants completed arriving in different childhood periods (Bleakley and Chin 2004; Wang and Wang 2011).

Figure 2 presents sibling fixed-effects estimates of the age-at-arrival effects on labor market outcomes before and after conditioning on a set of dummy indicators of years of completed education. If variation in economic outcomes by age at arrival reflects differences in education, we would expect reduced age-at-arrival effects when controlling for educational attainment. The panels show that a substantial direct effect of age at arrival on labor market outcomes remains after education is controlled for. A comparison of the gradients before and after the inclusion of the years-of-education dummy variables shows only a slightly reduced effect. Although the reduction relative to Norwegian-born immigrant children is larger among immigrants arriving in late childhood and adolescence, the results suggest that age at arrival does not primarily affect labor market outcomes through reduced educational attainment.

Using the linear specification of the age-at-arrival effect, Table 5 quantifies the net reduction after differences in education are controlled for. Except for employment (for which the baseline effect is negligible and nonsignificant), the reduction in age-at-arrival effects on labor market outcomes ranges between 25 % and 40 %. Thus, the age-at-arrival effect seems to be only partly attributable to educational differences between siblings. Importantly, this implies that the remaining net effects of age at arrival on economic outcomes does not seem to reflect causal pathways linked to length of formal education and related skill differences important for adult economic productivity.

-- Figure 2 --

< Table 5 >

Heterogeneous Effects by Region of Origin, Parental Education, and Child Gender

Given the arguments spelled out earlier, Table 6 presents results exploring whether subsample variation exists in the effect of age at arrival by region of origin, parental education, and child gender. Each panel summarizes results from sibling fixed-effects regressions in which the linear effect of age at arrival on adult socioeconomic outcomes is estimated using a set of interaction terms between region of origin, parental education, or child gender. To ease interpretation, I present the estimated coefficients for each subgroup (i.e., the sum of the main age-at-arrival coefficient and the coefficient for the interaction between the linear age-at-arrival term and the indicator of origin region, parental education, or female), which refer to the effect of one-year increments in age at arrival.[11]

< Table 6 >

Panel A reveals that the strongest effects of age at arrival are found among childhood immigrants arriving from Asia; the Middle East and Greater Arabia; and, to a slightly lesser

[11] The main effects of origin region and parental education will be absorbed by the sibling fixed effects.

extent, Africa and South America. Not surprisingly, age-at-arrival effects are generally small and nonsignificant among children immigrating from countries in Eastern Europe and rich, developed countries in Western Europe and North America. By contrast, panel B indicates less variation in age-at-arrival effects between children in academic and nonacademic families, which suggests that high parental education does not substantially alleviate the disadvantages related to immigration at older ages. Finally, the age-at-arrival effects in panel C are relatively similar for both genders, although they are slightly stronger among women. The larger age-at-arrival effect among women is most pronounced for education. In sum, these results suggest that older ages at arrival primarily affect the future life chances of childhood immigrants coming from geographically and culturally distant and less economically devloped origin countries, but less variation is found in age-at-arrival effects by parental education and child gender.

Discussion and Conclusions

This study provides new evidence on the causal relationship between childhood immigrants' age at arrival and their later socioeconomic life chances as adults. Building on theories of child development, I argue that childhood immigration and the timing of this event after an early period of childhood socialization and optimal learning may trigger adverse life-course trajectories that leave a lasting impact on adult socioeconomic attainments. To examine this empirically, I draw on panel data from population-wide administrative registries in Norway. To address concern for endogenous timing of childhood immigration, I use the panel structure of sibling data to relate within-family variation in adult outcomes between siblings to differences in their age at arrival. The sibling comparison enables me to hold constant all fixed family-level background characteristics shared by siblings using fixed-effects methods.

I report several key findings. First, age at arrival has a long-term effect on childhood immigrants' educational attainment and a broad range of employment-related domains in

adulthood that is robust to the inclusion of sibling fixed effects. These within-family relationships provide evidence that age at arrival exhibit a causal influence on the adult socioeconomic assimilation of childhood immigrants.

Second, the effects of childhood immigration on later-life socioeconomic outcomes are progressively stronger among children who arrive in late childhood and adolescence. Although differences in completed education and economic outcomes between Norwegian-born immigrant children and immigrants arriving in early childhood are relatively modest, socioeconomic disparities become gradually larger at older ages of arrival. Adolescent immigrants seem to be at a particular risk. This conclusion is also supported by results from stage-specific spline regressions in which the impact of a one-year higher age at arrival is allowed to vary between children arriving during early childhood, middle childhood, and adolescence.

Third, the age-at-arrival effects on adult labor market outcomes seem to only partially reflect effects mediated by educational attainment. After education is controlled for, between 60 % to 75 % of the within-family relationships remain, indicating substantial direct effects of age at arrival on adult economic well-being that are not captured by educational attainment level and related productivity-enhancing skills.

Fourth, the subsample analyses reveal considerable variation in the impact of age at arrival on adult attainments by childhood immigrants' region of origin. I find considerable age-at-arrival effects among children immigrating from low-income origin regions in Asia, the Middle East, Africa, and South America. By contrast, I do not find similar patterns among childhood immigrants arriving from developed countries in Europe and North America. Moreover, age-at-arrival effects vary less by child gender and parental education.

On the whole, the findings reported here suggest that children's chances of experiencing educational and labor market success become gradually more constrained as

they immigrate to Norway at later childhood stages. These clear age gradients in the effect of childhood immigration on adult socioeconomic outcomes corroborate and extend findings from previous research (Åslund et al. 2015; Beck et al. 2012; Bleakley and Chin 2004; Chiswick and DebBurman 2004; Guven and Islam 2015; Lee and Edmonston 2011; Myers et al. 2009). The present study's key contribution lies in the use of sibling comparisons to document how immigration at later childhood stages imposes contraints on human capital accumulation and labor market opportunties, providing a more convincing affirmation to the question of whether timing of childhood immigration is causally linked to children's adult socioeconomic life chances. Although these results support a causal interpretation of the relationship between age at arrival and adult outcomes, they are less informative about the developmental pathways through which these linkages arise.

Ideally, one would like to know the mechanisms through age at arrival affect later life chances. Given the critical role of language in learning across all domains, it is likely that language-related barriers shape late-arriving children's human capital accumulation and their ability to successfully navigate within the labor market. However, the finding that variation in labor market outcomes by age at arrival largely remains after education is controlled for is interesting, given that prior studies have found close links between education and the language-related effects of age at arrival on adult earnings (Bleakley and Chin 2004; Wang and Wang 2011). Nonetheless, unobserved language-related skills could be linked to economic success through pathways that are not directly linked to educational attainment. For example, better language proficiency is likely to improve individuals' on-the-job productivity through better communication skills and to expand access to job-related social networks; language proficiency may also reduce language-related employment discrimination affecting individuals with foreign-sounding accents. Furthermore, childhood immigrants could experience lower economic returns to education acquired prior to migration. In addition, the

labor market disadvantages experienced by childhood immigrants may reflect differences in sociocultural assimilation related to children's acculturation and ethnic identity formation.

Although the study provides valuable insights into the causal relationship between childhood immigrants' age at arrival and adult socioeconomic outcomes, some additional caveats should also be noted. First, the estimated relationships may be biased by unobserved child characteristics and family characteristics that vary over time, which are not captured by the sibling fixed effects. For example, if younger children and their parents learn from the difficulties that their older siblings experienced in the transition to adulthood, this might bias the estimated age-at-arrival effects within families. Second, the sibling comparison design also excludes single-child families and, perhaps more important, children who migrated unaccompanied by their parents. Adverse age-at-arrival effects on the prospects of socioeconomic incorporation in adulthood could be stronger for children immigrating on their own. Although beyond the scope of this study to pursue the issue further, keeping this limitation in mind is important when interpreting the results.

Despite these limitations, this study provides compelling evidence that processes related to childhood immigrants' age at arrival operate causally to shape their socioeconomic life-course trajectories in a lasting way. This finding is consistent with perspectives stressing that child development progresses through sensitive periods, with early formative years providing a crucial basis on which later skill formation and adult productivity depends (Knudsen et al. 2006). The developmental stages childhood immigrants pass through are likely to be common to all children, but the various challenges they face while adjusting to a new host society may hinder them from realizing their full potential. From a policy perspective, this suggests that children who immigrate at later stages of childhood and especially during adolescence should be targeted—for example, through intensive language-

training programs—to help ease their transition to adulthood and potential assimilation into the economic mainstream of their host societies.

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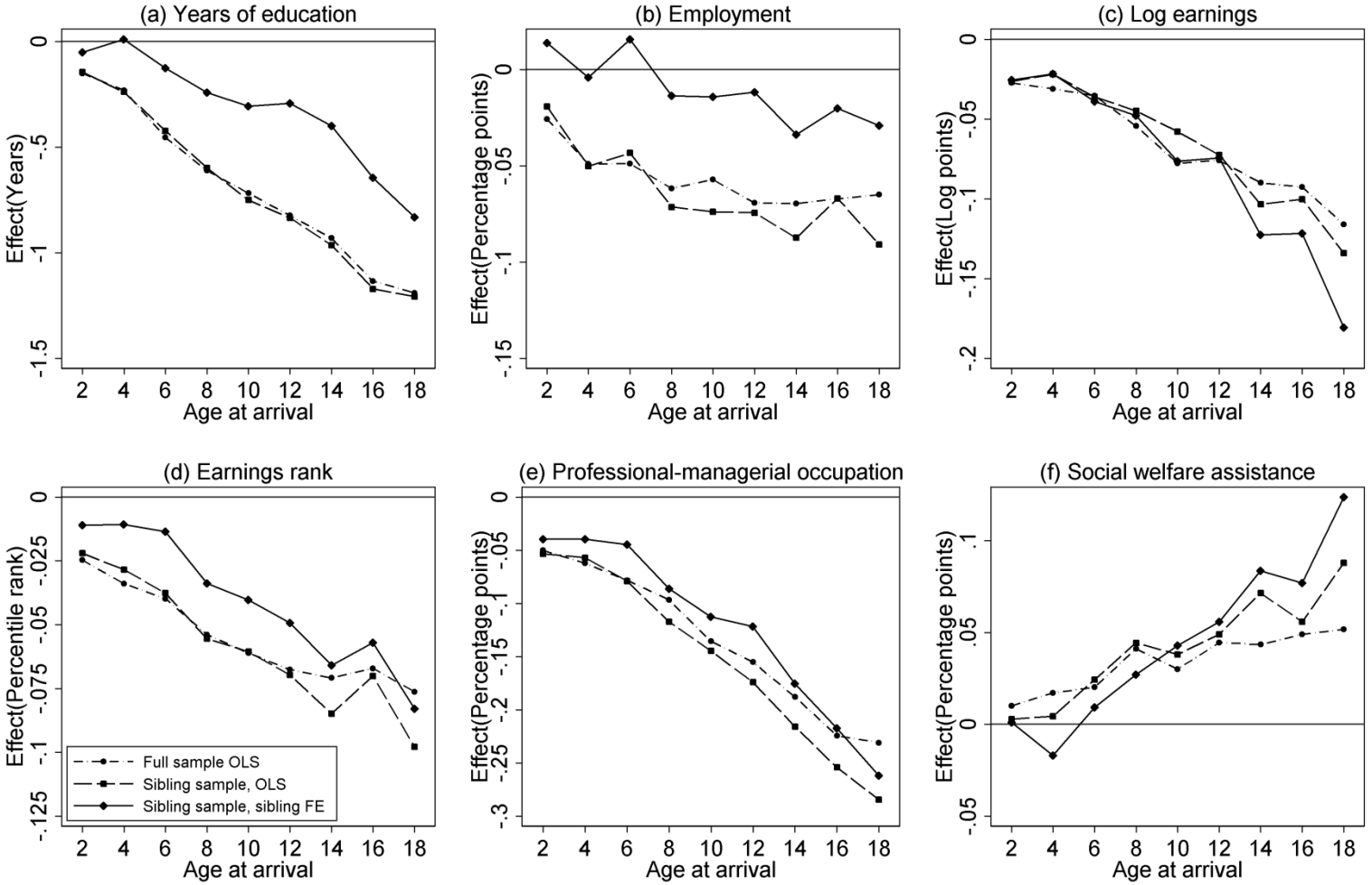

Fig. 1. Adult socioeconomic outcomes by age at arrival among childhood immigrants. The point estimates in each panel refer to the estimated difference in adult socioeconomic outcomes between immigrant-background children born in Norway (indicated by the horizontal solid bar at 0) and childhood immigrants by age at arrival for the full sample and the sibling sample. Cross-sectional OLS models control for country-of-origin dummy indicators, parental education, child gender, whether the child was the firstborn child of his or her mother, and birth cohort. Sibling fixed-effects models control for family fixed effects on the mother's ID, child gender, whether the child was the first-born child of his or her mother, and birth cohort

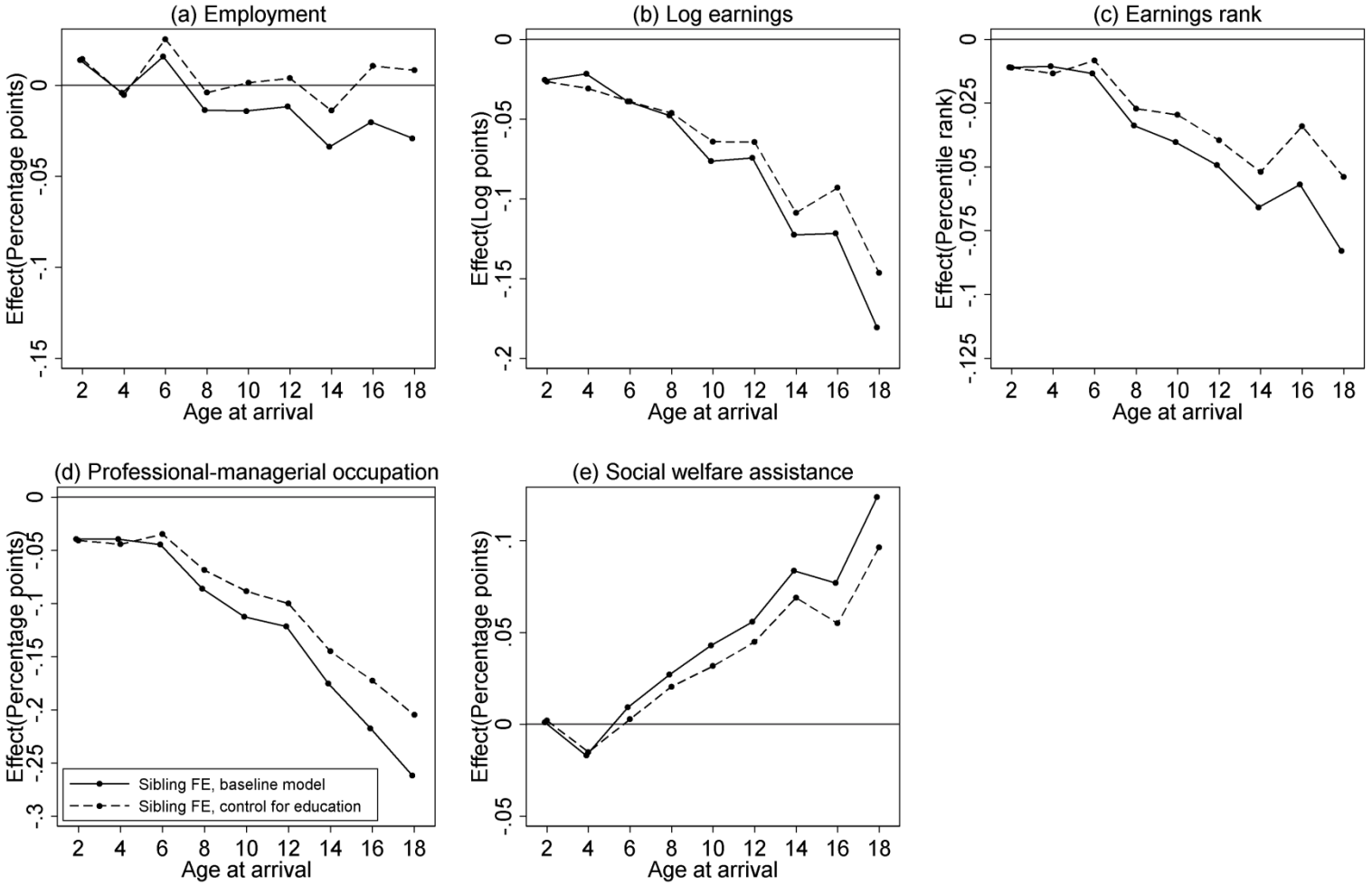

Fig. 2. Adult labor market outcomes by age at arrival among childhood immigrants before and after controlling for completed education. The point estimates in each panel refer to the estimated difference in adult labor market outcomes between immigrant-background children born in Norway (indicated by the horizontal solid bar at 0) and childhood immigrants by age at arrival for the sibling sample. Baseline sibling fixed-effects models control for family fixed effects on the mother's ID, child gender, whether the child was the firstborn child of his or her mother, and birth cohort. Sibling fixed-effects models controlling for education adjust for a set of dummy indicators of the child's years of completed education

Table 1 Descriptive statistics for variables used in analyses for full sample and sibling sample

	Full Sample			Sibling Sample		
Variable	Mean	SD	*N*	Mean	SD	*N*
Age at Arrival	9.151	6.407	29,405	7.420	5.971	17,372
Adult Socioeconomic Outcomes						
Years of education	12.508	2.59	29,405	12.545	2.560	17,372
Annual earnings (2012 U.S. $)	31,940	24,499	29,405	32,631	24,691	17,372
Employment	0.688		29,405	0.698		17,372
Log earnings	12.808	0.399	20,228	12.817	0.398	12,125
Earnings rank	0.419	0.300	29,405	0.426	0.301	17,372
Professional/managerial occupation	0.378		29,405	0.399		17,372
Social welfare assistance	0.253		29,405	0.253		17,372
Female (1 = female, 0 = male)	0.466		29,405	0.476		17,372
Firstborn Child of Mother	0.546		29,405	0.319		17,372
Birth Cohort	1975.45	5.30	29,405	1975.45	4.93	17,372
Parental Education						
Basic education	0.348		29,405	0.437		17,372
Some upper secondary	0.058		29,405	0.062		17,372
Full upper secondary	0.078		29,405	0.087		17,372
Lower tertiary	0.139		29,405	0.152		17,372
Higher tertiary	0.054		29,405	0.057		17,372
No education registered	0.323		29,405	0.206		17,372

Note: Standard deviations are not presented for discrete variables because the full distribution of responses is shown.
Source: Author's calculations based on Norwegian administrative registry data compiled by Statistics Norway.

Table 2 Adult socioeconomic outcomes by age at arrival for full sample and sibling sample

	Born in Norway		Arrival at Age 0–6		Arrival at Age 7–12		Arrival at Age 13–18	
	Full Sample	Sibling Sample	Full Sample	Sibling Sample	Full Sample	Sibling Sample	Full Sample	Sibling Sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years of Education	13.125	13.033	12.980	12.884	12.501	12.391	11.989	11.973
	(2.607)	(2.588)	(2.629)	(2.629)	(2.510)	(2.501)	(2.510)	(2.409)
Annual Earnings (2012 U.S. $)	37,314	37,207	34,376	34,195	31,530	31,294	28,371	28,388
	(27,026)	(26,455)	(26,222)	(25,700)	(24,334)	(24,521)	(21,679)	(21,138)
Employment	0.746	0.748	0.710	0.715	0.684	0.677	0.650	0.660
	(0.435)	(0.434)	(0.454)	(0.452)	(0.465)	(0.468)	(0.477)	(0.474)
Log Earnings	12.894	12.890	12.852	12.844	12.804	12.805	12.737	12.724
	(0.413)	(0.408)	(0.411)	(0.404)	(0.395)	(0.391)	(0.374)	(0.369)
Earnings Rank	0.475	0.472	0.444	0.446	0.411	0.410	0.385	0.384
	(0.310)	(0.308)	(0.309)	(0.308)	(0.299)	(0.299)	(0.287)	(0.283)
Professional/Managerial Occupation	0.500	0.498	0.456	0.463	0.374	0.369	0.284	0.285
	(0.500)	(0.500)	(0.498)	(0.499)	(0.484)	(0.482)	(0.451)	(0.452)
Social Welfare Assistance	0.198	0.205	0.222	0.225	0.260	0.268	0.297	0.306
	(0.399)	(0.404)	(0.416)	(0.418)	(0.439)	(0.443)	(0.457)	(0.461)
Number of Observations	5,844	4,449	4,715	3,347	7,719	5,173	11,127	4,403

Note: Means, with standard deviations shown in parentheses.

Table 3 Regression estimates predicting educational attainment and adult labor market outcomes by age at arrival for sibling sample

	Dependent Variable											
	Years of Education		Employment		Log Earnings		Earnings Rank		Professional/Managerial Occupation		Social Welfare Assistance	
	OLS (1)	Sibling FE (2)	OLS (3)	Sibling FE (4)	OLS (5)	Sibling FE (6)	OLS (7)	Sibling FE (8)	OLS (9)	Sibling FE (10)	OLS (11)	Sibling FE (12)
Age at Arrival (ref. = Norwegian-born)												
0–2 years	–0.145†	–0.051	–0.019	0.014	–0.026†	–0.025	–0.022*	–0.011	–0.053**	–0.040†	0.003	0.001
	(0.084)	(0.097)	(0.015)	(0.020)	(0.015)	(0.022)	(0.010)	(0.013)	(0.017)	(0.021)	(0.014)	(0.018)
3–4 years	–0.239**	0.011	–0.050**	–0.004	–0.022	–0.022	–0.028**	–0.011	–0.057***	–0.040†	0.004	–0.017
	(0.086)	(0.108)	(0.016)	(0.023)	(0.016)	(0.026)	(0.010)	(0.015)	(0.017)	(0.024)	(0.014)	(0.021)
5–6 years	–0.423***	–0.126	–0.043**	0.016	–0.036*	–0.039	–0.038***	–0.014	–0.079***	–0.045†	0.024†	0.009
	(0.080)	(0.120)	(0.015)	(0.025)	(0.015)	(0.028)	(0.010)	(0.016)	(0.016)	(0.026)	(0.014)	(0.024)
7–8 years	–0.598***	–0.242†	–0.071***	–0.014	–0.045**	–0.048	–0.055***	–0.034†	–0.117***	–0.086**	0.044**	0.027
	(0.079)	(0.133)	(0.015)	(0.029)	(0.015)	(0.032)	(0.010)	(0.018)	(0.015)	(0.028)	(0.014)	(0.028)
9–10 years	–0.751***	–0.306*	–0.074***	–0.014	–0.058***	–0.076*	–0.061***	–0.041*	–0.145***	–0.112***	0.038**	0.043
	(0.076)	(0.146)	(0.014)	(0.032)	(0.014)	(0.035)	(0.009)	(0.020)	(0.015)	(0.031)	(0.013)	(0.031)
11–12 years	–0.835***	–0.293†	–0.074***	–0.012	–0.073***	–0.074†	–0.069***	–0.050*	–0.174***	–0.121***	0.049***	0.056†
	(0.075)	(0.163)	(0.014)	(0.036)	(0.014)	(0.039)	(0.009)	(0.022)	(0.015)	(0.034)	(0.013)	(0.034)
13–14 years	–0.964***	–0.400*	–0.087***	–0.034	–0.104***	–0.123**	–0.084***	–0.066**	–0.216***	–0.175***	0.071***	0.083*
	(0.079)	(0.180)	(0.015)	(0.040)	(0.014)	(0.043)	(0.009)	(0.024)	(0.016)	(0.038)	(0.014)	(0.038)
15–16 years	–1.171***	–0.645**	–0.067***	–0.020	–0.100***	–0.122*	–0.070***	–0.057*	–0.254***	–0.217***	0.056***	0.077†
	(0.083)	(0.200)	(0.015)	(0.044)	(0.015)	(0.047)	(0.010)	(0.027)	(0.016)	(0.042)	(0.015)	(0.041)
17–18 years	–1.207***	–0.832***	–0.091***	–0.029	–0.134***	–0.181***	–0.098***	–0.083**	–0.284***	–0.262***	0.088***	0.124**
	(0.104)	(0.226)	(0.019)	(0.049)	(0.019)	(0.053)	(0.012)	(0.030)	(0.019)	(0.046)	(0.019)	(0.047)
Female	0.379***	0.285***	–0.151***	–0.171***	–0.202***	0.013	–0.162***	–0.173***	0.018*	0.013	0.131***	0.134***
	(0.036)	(0.039)	(0.007)	(0.009)	(0.007)	(0.011)	(0.004)	(0.005)	(0.007)	(0.008)	(0.007)	(0.008)
Firstborn Child of Mother	0.280***	0.209***	0.014†	0.000	0.023**	–0.217***	0.017***	0.003	0.048***	0.035***	–0.022**	–0.016†
	(0.039)	(0.045)	(0.008)	(0.010)	(0.007)	(0.009)	(0.005)	(0.006)	(0.008)	(0.010)	(0.007)	(0.009)
Parental Education (ref. = basic)												
Some upper secondary	0.400***		0.024		0.034*		0.025*		0.065***		–0.036*	
	(0.094)		(0.015)		(0.015)		(0.010)		(0.018)		(0.015)	
Full upper secondary	0.592***		0.031*		0.044**		0.034***		0.090***		–0.041**	
	(0.086)		(0.014)		(0.014)		(0.009)		(0.016)		(0.013)	
Lower tertiary	1.169***		0.041***		0.086***		0.055***		0.159***		–0.059***	
	(0.071)		(0.011)		(0.012)		(0.008)		(0.013)		(0.010)	
Higher tertiary	2.057***		0.048**		0.127***		0.077***		0.223***		–0.066***	
	(0.109)		(0.017)		(0.019)		(0.013)		(0.019)		(0.015)	
No education registered	–0.062		–0.033**		–0.003		–0.020**		–0.017		–0.003	
	(0.058)		(0.011)		(0.010)		(0.007)		(0.011)		(0.010)	

Country-of-Origins Dummy Variables	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Sibling Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean Outcome	12.545	12.545	0.698	0.698	12.817	12.817	0.426	0.426	0.399	0.399	0.253	0.253
Number of Observations	17,372	17,372	17,372	17,372	12,125	12,125	17,372	17,372	17,372	17,372	17,372	17,372
R^2	.195	.650	.074	.478	.157	.644	.136	.549	.119	.547	.070	.469

Notes: All models include controls for birth cohort dummy variables. Family fixed effects on the mother's ID. Huber-White standard errors in parentheses are robust to within-family clustering and heteroskedasticity. Coefficients from linear probability models are reported for binary outcomes (i.e., employment, professional/managerial occupation, and social welfare assistance).
$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$, $^{***}p < .001$ (two-tailed tests)

Table 4 Linear and stage-specific spline specifications of the effect of one-year increases in age at arrival on educational attainment and adult labor market outcomes

	Dependent Variable					
	Years of Education (1)	Employment (2)	Log Earnings (3)	Earnings Rank (4)	Professional/Managerial Occupation (5)	Social Welfare Assistance (6)
Panel A. Linear Specification						
Age-at-arrival linear	–0.0497***	–0.0025	–0.0096***	–0.0046**	–0.0139***	0.0070**
	(0.0125)	(0.0027)	(0.0029)	(0.0017)	(0.0026)	(0.0026)
Sibling fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.650	.478	.644	.549	.547	.469
Number of Observations	17,372	17,372	12,125	17,372	17,372	17,372
Panel B. Spline Specification						
Stage-specific linear splines						
Arrival at age 0–6	–0.0266	0.0007	–0.0055	–0.0025	–0.0075†	0.0010
	(0.0198)	(0.0043)	(0.0046)	(0.0027)	(0.0041)	(0.0041)
Arrival at age 7–12	–0.0345*	–0.0047	–0.0087*	–0.0059*	–0.0116**	0.0089*
	(0.0176)	(0.0038)	(0.0041)	(0.0023)	(0.0037)	(0.0036)
Arrival at age 13–18	–0.0913***	–0.0014	–0.0145**	–0.0041	–0.0222***	0.0082†
	(0.0197)	(0.0044)	(0.0046)	(0.0026)	(0.0040)	(0.0040)
Sibling fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.650	.478	.644	.549	.547	.469
Number of Observations	17,372	17,372	12,125	17,372	17,372	17,372
Tests of difference (p values)						
Arrival at age 0–6 vs. 7–12	0.753	0.325	0.593	0.315	0.444	0.119
Arrival at age 0–6 vs. 13–18	0.003	0.664	0.087	0.591	0.001	0.121
Arrival at age 7–12 vs. 13–18	0.028	0.568	0.341	0.594	0.051	0.890

Notes: All models include controls for child sex, whether the child was the firstborn child of his or her mother, birth cohort dummy variables, and family fixed effects on the mother's ID. Huber-White standard errors robust to within-family clustering and heteroskedasticity in parentheses. Coefficients from linear probability models are reported for binary outcomes (i.e., employment, professional/managerial occupation, and social welfare assistance).

†$p < .10$; *$p < .05$; **$p < .01$, ***$p < .001$ (two-tailed tests)

Table 5 The mediating role of educational attainment in age-at-arrival effects on adult labor market outcomes

	Dependent Variable				
	Employment (1)	Log Earnings (2)	Earnings Rank (3)	Professional/Managerial Occupation (4)	Social Welfare Assistance (5)
Panel A. Without Controls for Education					
Age-at-arrival linear	–0.0025	–0.0096***	–0.0046**	–0.0139***	0.0070**
	(0.0027)	(0.0029)	(0.0017)	(0.0026)	(0.0026)
Dummy Variables for years of education	No	No	No	No	No
Sibling fixed effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	17,372	12,125	17,372	17,372	17,372
Panel B. With Controls for Education					
Age-at-arrival linear	–0.0003	–0.0072**	–0.0028†	–0.0103***	0.0052*
	(0.0026)	(0.0028)	(0.0016)	(0.0023)	(0.0025)
Reduction (%)	0.880	0.250	0.391	0.259	0.257
Years-of-education dummy variables	Yes	Yes	Yes	Yes	Yes
Sibling fixed effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	17,372	12,125	17,372	17,372	17,372

Notes: All models include controls for child sex, whether the child was the firstborn child of his or her mother, birth cohort dummy variables, and family fixed effects on the mother's ID. Huber-White standard errors robust to within-family clustering and heteroskedasticity in parentheses. Coefficients from linear probability models are reported for binary outcomes (i.e., Employment, Professional/managerial occupation, and Social welfare assistance).

$^{\dagger}p < .10$; *$p < .05$; **$p < .01$, ***$p < .001$ (two-tailed tests)

Table 6 Heterogeneous linear effects of age at arrival on educational attainment and adult labor market outcomes by region of origin, parental education, and child gender

	Years of Education (1)	Employment (2)	Log Earnings (3)	Earnings Rank (4)	Professional/Managerial Occupation (6)	Social Welfare Assistance (7)
Panel A. By Region of Origin						
West	0.0163	0.0025	–0.0017	0.0003	–0.0005	0.0077
	(0.0266)	(0.0059)	(0.0056)	(0.0036)	(0.0057)	(0.0049)
Eastern Europe	–0.0048	0.0016	0.0019	0.0033	–0.0097	–0.0021
	(0.0274)	(0.0061)	(0.0059)	(0.0038)	(0.0064)	(0.0054)
Asia	–0.0659***	–0.0045	–0.0170***	–0.0084***	–0.0207***	0.0097**
	(0.0166)	(0.0034)	(0.0036)	(0.0021)	(0.0034)	(0.0032)
Middle East and Greater Arabia	–0.0637***	–0.0020	–0.0056	–0.0043*	–0.0129***	0.0057†
	(0.0147)	(0.0032)	(0.0035)	(0.0019)	(0.0028)	(0.0031)
Africa and South America	–0.0258	–0.0036	–0.0090*	–0.0031	–0.0106**	0.0081†
	(0.0187)	(0.0044)	(0.0045)	(0.0025)	(0.0041)	(0.0042)
Number of Observations	17,372	17,372	12,125	17,372	17,372	17,372
Panel B. By Parental Education						
Academic family	–0.0340*	–0.0004	–0.0093**	–0.0034†	–0.0105***	0.0067*
	(0.0148)	(0.0032)	(0.0034)	(0.0020)	(0.0031)	(0.0030)
Non-academic family	–0.0530***	–0.0030	–0.0096***	–0.0048**	–0.0146***	0.0070**
	(0.0126)	(0.0027)	(0.0029)	(0.0017)	(0.0026)	(0.0026)
Number of Observations	17,372	17,372	12,125	17,372	17,372	17,372
Panel C. By Child Gender						
Men	–0.0353**	–0.0003	–0.0097***	–0.0045**	–0.0138***	0.0056*
	(0.0129)	(0.0028)	(0.0029)	(0.0017)	(0.0026)	(0.0027)
Women	–0.0613***	–0.0044	–0.0094**	–0.0047**	–0.0140***	0.0080**
	(0.0129)	(0.0028)	(0.0030)	(0.0017)	(0.0026)	(0.0026)
Number of Observations	17,372	17,372	12,125	17,372	17,372	17,372

Notes: Coefficients refer to the linear effect of a one-year increase in age at arrival on the outcome of interest. In panel A, the coefficients represent the sum of the main effect (i.e., for the reference group West) and the interaction term for the specific origin regions. In panel B, the coefficients represent the sum of the main effect (i.e., for the reference group Academic family) and the interaction term for Non-academic family. In panel C, the coefficients represent the sum of the main effect (i.e., for the reference group men) and the interaction term for women. All models include controls for child sex, whether the child was the firstborn of his or her mother, birth cohort dummy variables, and family fixed effects on the mother's ID. Huber-White standard errors in parentheses are robust to within-family clustering and heteroskedasticity. Coefficients from linear probability models are reported for binary outcomes (i.e., employment, professional/managerial occupation, and social welfare assistance).

†$p < .10$; *$p < .05$; **$p < .01$, ***$p < .001$ (two-tailed tests)

Appendix

Table 7 Geographical origin of children of immigrant-origin for full sample and sibling sample

	Full Sample		Sibling Sample		
Regions of Origin	Number of Observations	%	Number of Observations	%	Countries of Origin (n > 100) in sibling sample
West	4,469	15.2	2,284	13.2	Denmark (n = 697), Sweden (n = 334), United Kingdom (n = 262), Germany (n = 194), Iceland (n = 175), Finland (n = 139), The Netherlands (n = 135), and United States (n = 82)
Eastern Europe	4,243	14.4	1,991	11.5	Bosnia-Hercegovina (n = 646), Poland (n = 311), Kosovo (n = 301), Macedonia (n = 238), Croatia (n = 155), Serbia (n = 138), and Hungary (n = 99)
Asia	7,380	25.1	4,510	26.0	Vietnam (n = 2,614), India (n = 633), Philippines (n = 373), Sri Lanka (n = 346), Thailand (n = 175), China (n = 155), and Hong Kong (n = 69)
Middle East and Greater Arabia	8,850	30.1	6,262	36.1	Pakistan (n = 3,733), Turkey (n = 1,476), Iran (n = 589), Iraq (n = 274), Syria (n = 53), and Afghanistan (n = 51)
Africa and South America	4,463	15.2	2,325	13.4	Chile (n = 732), Morocco (n=624), Somalia (n = 293), Eritrea (n = 76), Cape Verde (n = 53), and Kenya (n = 51)
Total	29,405	100.0	17,372	100.0	

Notes: For each region of origin, all countries with 50 or more child observations are listed. If the child was born in Norway, country of origin is derived from information on the mother's country of birth.