A Second Soul: Age at Immigration, Language, and Cultural Assimilation*

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Abstract

This paper studies the long-run cultural assimilation of immigrant children, focusing on age-at-arrival effects, intermarriage, fertility, and the role of language acquisition. Using Israeli administrative records, our analysis follows Former Soviet Union Jews who migrated to Israel immediately following the 1989 unexpected lifting of Soviet emigration restrictions—a setting which we argue lends a plausibly causal interpretation to age-at-arrival effects. To study Hebrew proficiency, we introduce a revealed-preference measure of language acquisition: the language in which a person chooses to take the university admissions standardized test. Given wide differences in fertility norms between the USSR and Israel, we assess cultural assimilation through intermarriage with natives, age at first child, and completed fertility. We find that even small differences in arrival age between 7 and 17 can have large impacts in language acquisition and long-run integration. Specifically, age at arrival affects immigrant-native gaps in out-migration probabilities, residential segregation, intermarriage, and fertility. We conclude that exposure to Israel's high-fertility norms raises immigrants' completed fertility: focusing on the probability of having 3 or more children, arriving in Israel at age 7 compared to age 17 closes 35–41% of the gap between higher-fertility natives and lower-fertility age-17 arrivals. Lastly, we quantify a crucial mediating role of local language proficiency in shaping long-term assimilation outcomes.

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1 Introduction

Recent trends in immigration and population aging across developed countries have brought immigration policy and immigrants' integration to the forefront of the policy and political debate. Immigration has the potential to increase aggregate productivity (Burchardi et al., 2020) and rejuvenate aging societies.[1] However, natives' anti-immigration sentiments are oftentimes mostly driven by cultural mismatch concerns (Tabellini, 2020; Alesina and Tabellini, 2024). In this context, it is important to improve our understanding on determinants of cultural integration and assimilation in large migration episodes.

In this paper, we analyze age-at-arrival effects on the long-term cultural assimilation of immigrants who arrive to their destination country as children. As opposed to adults, immigrant children are in the midst of human capital development and identity formation. Age at migration might be a key determinant of cultural assimilation to the extent that children of different ages arrive at different developmental, educational, and socialization milestones. Age at arrival also determines the degree of exposure to the destination country, which can directly shape cultural assimilation (Bisin and Verdier, 2001). However, identifying age-at-arrival effects is associated with a series of challenges: the endogeneity of migration decisions, selection driven by out-migration, and data limitations in tracking long-term outcomes. Moreover, while language acquisition is a plausibly important driver of integration, it is typically unobserved in longitudinal administrative datasets.

We overcome these empirical challenges studying Former Soviet Union (FSU) Jews who migrated to Israel shortly after the unexpected lifting of Soviet emigration restrictions in 1989. We argue for the exogeneity of the age at arrival of immigrant children given the pent-up demand to leave the FSU and desire to escape persecution (Abramitzky et al., 2022). We can track child immigrants in Israeli administrative data for up to 29 years after arrival, observing out-migration, residential sorting, intermarriage, and fertility outcomes. FSU Jews were very different from Israeli natives and faced significant cultural barriers (Remennick, 2007), leaving ample scope for variation in long-term cultural assimilation. As FSU migrants generally did not speak Hebrew, language presented an important hurdle to integration. Our data include a unique, high-stakes revealed-preference measure of Hebrew knowledge at young adulthood—the language in which a person chooses to take the university admissions standardized test—allowing us to quantify the role of language acquisition in cultural assimilation.

Our empirical approach consists of comparing the long-term outcomes of FSU immigrant children who arrived in Israel at different ages between 1990–1991. Benchmarking age-at-arrival differences to natives of the same birth cohorts allows us to control for time effects in the outcomes of interest. Based on the historical context and supporting balance tests, we argue for a causal interpretation of age-at-arrival differentials.[2] Additionally, we

[1]See, for example, reports by Peri (2020) and Gokhale (2024).

[2]The bulk of the post-1989 FSU migration wave to Israel occurred between 1990–1999 (see Figure A1). The exogeneity of age at arrival is more plausible for the early arrivals we study, which can be thought of as refugees, while later waves can be thought of as economic migrants (Abramitzky et al., 2022) and for whom typical selection concerns regarding the timing of migration are more likely.

put forward an alternative, intra-family research design based on comparing siblings who arrived in Israel at different ages.

A key advantage of our data and setting is the availability of a revealed-preference measure of child immigrants' Hebrew knowledge in young adulthood. Students applying for higher education programs in Israel take a standardized test called Psychometric Entrance Test (PET), typically between ages 18–25. Crucially, students can take the test in Hebrew or in Russian (as well as Arabic, English, and French) and this choice is reflected in our data. Given the high stakes and that students can freely choose, we interpret the choice to take the test in Hebrew as a revealed-preference measure of Hebrew knowledge. We can observe this measure for those who take the university entrance test, which represent around 47% of our population of interest.

Our first set of empirical results quantify age-at-arrival effects on Hebrew language acquisition. We find a strong pattern of age-at-arrival effects on the probability of taking the PET test in Hebrew. FSU immigrants who arrived at age 7 are as likely as natives to take the test in Hebrew, whereas practically none of the ones who arrived at age 17 do so. The drop in the probability of Hebrew test-taking between ages 7–17 is strongly *non-linear*, with most of the drop occurring during a few critical years, between ages of arrival 9–14. Thus, our evidence suggests that even small differences in the age at arrival between ages 9–14 can have meaningful, long-lasting consequences for language integration.

Our data allow us to study an administrative measure of out-migration—i.e., leaving Israel and settling residence elsewhere—for immigrants and natives alike. We argue that out-migration is a meaningful summary measure of (lack of) integration. Moreover, as most FSU child immigrants who eventually leave Israel are highly educated, recent policy debates have worried about such "brain drain," which has clear consequences for the fiscal effects of immigration.[3] The immigrant-native gap in the probability of out-migration by age 35 is significantly larger for older arrivals relative to younger ones. The out-migration gap between age-17 and age-7 arrivals is roughly as large as the gap between natives and age-7 arrivals (both are equal to about five percentage points).

Next, we study residential sorting as a measure of integration, comparing the cities of residence at age 35 of FSU children who arrived at different ages. We characterize cities by the share of their population who are FSU immigrants, building on literature that studies residential segregation in immigrant enclaves (e.g., Eriksson and Ward, 2019). We find significant age-at-arrival gradients whereby those who arrived in Israel at ages 16–17 lived by age 35 in cities with FSU population shares that were on average 2 percentage points higher than those who arrived at age 7.

The cultural integration of younger arrivals, both male and female, is also reflected in the probability of marrying a native. We find a steep gradient between arrival age and the probability of matching with a native spouse. For instance, the differential probability of marrying a native for FSU children who arrived at age 17 is is around -0.65, while the corresponding one for those arrived at age 17 is about -0.40, closing over 40% of age-17

[3]See, for instance, Jeffay (2016).

arrivals' gap with natives.

Our last set of cultural assimilation outcomes relate to fertility behavior. The reasons are twofold. First, fertility has intrinsic interest in the context of the relationship between immigration and demographic decline. Second, it represents a clear dimension of assimilation, as the cultural norms between the FSU and Israel were quite distinct—relative to the FSU, the Israeli norm was for women to have their first child at an older age, but have a greater number of children overall.[4] We find age-at-arrival effects that point towards assimilation in fertility norms in both of these dimensions. Relative to FSU immigrants who arrived age 17, those who arrived at younger ages had their first child later and had a greater number of kids by age 39.

Specifically, for women, the effect on total number of children of arriving in Israel ten years earlier closes around 31% of the fertility gap between natives and immigrants who arrived at age 17. When examining the effects of age-at-arrival at different parts of the number of children distribution, we find that the strongest evidence for assimilation—the steepest age-at-arrival gradient—is present in the probability of having three children. We interpret this as evidence of cultural integration along the fertility norm, as the total fertility rate in the late 1980s was about two in the FSU and about three in Israel.

Presumably, Hebrew language acquisition could be a key mediator of age-at-arrival effects on cultural assimilation outcomes. Moving to a less segregated city and matching with a native-born spouse could be easier and more rewarding for FSU immigrants who reached young adulthood with proficient Hebrew, compared to those who did not. While it is unclear whether Hebrew knowledge has direct effects on assimilation in fertility behavior once we condition on having a native spouse, it could still have indirect effects by influencing the probability of having such a marriage market match in the first place.

Observing our revealed preference measure of Hebrew knowledge thus presents a valuable opportunity to rigorously explore such language mediation effects. In ongoing work, we are estimating a model that will allow us to quantify all direct and indirect mediating effects of Hebrew, while allowing for equilibrium effects in the marriage market. Here, we present preliminary evidence of mediation effects by estimating age-at-arrival profiles in cultural assimilation that net out the choice to take the PET test in Hebrew. Results from this exercise show that accounting for Hebrew knowledge indeed flattens age-at-arrival gradients, especially for out-migration probabilities, residential segregation, probability of a native spouse, and number of children.

Contribution to the literature

A rich literature studies immigrants' cultural assimilation (Abramitzky et al., 2020) and age-at-arrival effects on the long-run integration of child immigrants. Many such works mainly (but not exclusively) focus on labor market outcomes (Friedberg, 1992; Bleakley and Chin, 2004; Alexander and Ward, 2018; Connolly et al., 2023; Åslund et al., 2023; Aloni and Avivi, 2024; Kerr et al., 2024), while Bleakley and Chin (2010) and Duncan and Trejo

[4]Among OECD countries, Israel has, by far, the highest total fertility rate (equal to 2.9 according to the UN).

(2025) document age-at-arrival effects on language, geographical sorting, family formation, and identity transmission. Related papers that focus, as we do, on the determinants of and returns to language acquisition include Bleakley and Chin (2004, 2010), Berman et al. (2003), and Lang and Siniver (2009).

We contribute to this literature in several ways. Our context is particularly valuable in that we can leverage policy-induced exogenous variation in age at arrival across a wide range of arrival ages, track a variety of cultural assimilation outcomes in long-term administrative data, and observe a high-stakes, revealed-preference measure of language acquisition in administrative data. In contrast, language proficiency is typically either observed only in cross-sectional survey/census data, in a self-reported manner (e.g., Bleakley and Chin, 2004, 2010; Berman et al., 2003; Kerr et al., 2024), proxied by mother tongue (Adserà and Ferrer, 2014), or altogether unobserved in most administrative datasets (e.g., Åslund et al., 2023; Connolly et al., 2023). While language as a mediator has been proposed in instrumental variables contexts (Bleakley and Chin, 2004, 2010), we will be able to carry out a richer mediation analysis that teases out direct and indirect effects in the causal chain going from age at arrival, language, the marriage market, and fertility.

A second strand of relevant literature studies the interplay between immigration, family formation, and fertility (Adserà and Ferrer, 2015). Topics include intermarriage with natives (Furtado and Trejo, 2013), age-at-arrival effects in fertility outcomes consistent with assimilation (Adserà et al., 2012; Adserà and Ferrer, 2014), and the persistence of fertility norms among second-generation immigrants (Fernández and Fogli, 2009).[5]

A distinguishing feature of our setting is the fact that migrants' origin country (FSU) had lower fertility than the destination country (Israel), implying that assimilation points in the direction of having a greater number of children. Similarly, Tønnessen and Mussino (2020) and Mussino et al. (2021) study age-at-arrival effects and fertility behavior of immigrants in Nordic countries from lower-fertility origins. However, these studies cannot tease apart causal age-at-arrival effects from selection, which our setting allows us to do. Moreover, in the context of immigration-fertility interactions, we will be able to provide a novel, precise quantification of the mediating roles played by language acquisition and intermarriage with natives.

Beyond the context of immigration, this paper adds new insights to the body of work on financial, policy, and cultural drivers of fertility. Such drivers have gathered renewed attention in a context of declining fertility around the globe at below-replacement levels. Evidence on positive fertility effects of pecuniary incentives or childcare/maternity policies are mixed (Milligan, 2005; Lalive and Zweimüller, 2009; Cohen et al., 2013; Bauernschuster et al., 2016; Dahl et al., 2016; Thomas et al., 2022), even if in many of these papers it is challenging to identify effects on *completed* fertility, as we are arguably able to do. Beyond policies and monetary incentives, some papers illustrate the role that culture and norms can play on fertility. These papers, however, all document *negative* effects on fertility in the context of developing economies undergoing the fertility transition (Jensen and Oster, 2009;

[5] Other papers have studied immigrants' fertility in Israel, using birth records, surveys, and census data, without focusing on age-at-arrival effects of child immigrants (Nahmias, 2004; Okun and Kagya, 2012).

La Ferrara et al., 2012; Beach and Hanlon, 2023) or teenage pregnancies in the US (Kearney and Levine, 2015). Instead, this paper provides new evidence on how cultural exposure to high fertility norms can meaningfully increase fertility.

The remainder of this paper is structured as follows. Section 2 provides an overview of the relevant historical and institutional context. Section 3 describes the data. Section 4 lays out our empirical model and identification assumptions. Section 5 presents the main results on age-at-arrival effects, while Section 6 provides evidence on the mediating role of Hebrew knowledge. Section 7 concludes.

2 Historical and Institutional Context

2.1 FSU migration to Israel

A mass exodus of FSU Jews began in 1989 following the unexpected lifting of Soviet emigration restrictions.[6] Most FSU Jews migrated to Israel—which encouraged them to do so and granted them citizenship on arrival—while others went to Germany or the US. Between 1989–1999, around 840,000 FSU Jews migrated to Israel. While more educated than native Israelis, these immigrants faced large native-migrant earnings gaps upon arrival on Israel, which eventually closed after three decades (Arellano-Bover and San, 2024).

Abramitzky et al. (2022) argue that FSU migrants who arrived in Israel between 1989–1992 can be described as refugees, in contrast to those who arrived from 1993 onward which they describe as economic migrants. Following this interpretation, our empirical analyses focus on the early, 1990–1991 arrivals. Families who arrived during these two years were more likely to migrate driven by persecution, and the spike in arrivals during those early years (Figure A1) is suggestive of a pent-up desire to leave the FSU. We later argue that these features are useful to identify year-of-arrival effects for those who arrived as children. The intuition behind this is that 1990–1991 families left whenever they got the chance, rather than at a carefully chosen time that potentially took into consideration the optimal age of migration for their children.

Upon arrival, FSU Jews received Israeli citizenship according to the Law of Return. Citizenship was granted automatically, regardless of immigrants' age, implying that children who arrived at different ages faced the same legal environment. Moreover, granting citizenship implied that intermarriage with natives is arguably a more direct measure of cultural assimilation, as there were no incentives to marry a native for immigration regulation reasons (Adda et al., 2025).

2.2 Cultural differences between FSU immigrants and Israeli natives

FSU immigrants arriving in Israel faced significant cultural differences with respect to existing residents. Language presented a challenging barrier as the vast majority of FSU immigrants did not speak Hebrew. Moreover, the Soviet regime had for decades suppressed

[6] Bolden (2021) provides a detailed account of Soviet Jewish emigration prior to the 1990s, highlighting the significant barriers individuals faced when attempting to leave the USSR.

Jewish cultural and religious life, which resulted in FSU Jews not following many Jewish practices that are commonplace in Israel. The memoirs of Saul Tetelbaum (Tetelbaum, 2009), an FSU Jew who migrated to the US, eloquently describe this phenomenon:

> *As a result of systematic eradication of Jewish culture, tradition, and language during many years, everything Jewish in the lives of Soviet Jews disappeared. Soviet authorities created a new type of Jew who was an atheist, a person who didn't speak any Jewish language, who knew neither Jewish culture, nor Jewish traditions, nor Jewish history—a Jew without visible Jewish qualities. One single thing indicated that a person was a Jew: it was a record in the person's passport; the record that the person inherited from his/her parents.*

Remennick (2007) provides a detailed description of the resulting cultural clashes between FSU and incumbent Israelis. Such clashes include the celebration of *Novy God* (New Year) using Christmas-like fir trees, the lack of recognition of halakhically Jewish status among some FSU migrants and resulting implications, and a stark divide in school norms regarding discipline and teachers' authority (stricter in FSU relative to Israel), to name a few.

2.3 Fertility norms

Israeli norms favor large families, to a degree that is unparalleled among rich countries. It has, by far, the highest total fertility rate (TFR) among OECD countries, equal to 3 in 2019 (Figure A2). Comparing Israel to the FSU yields striking results. Between 1975 and 1990, the TFR in Israel fluctuated between 3.6 and 2.8, while TFRs for what is now Russia and Ukraine ranged between 1.9–2.2 and 1.9–2.1, respectively (Figure A3). Among non-ultra-Orthodox Jewish women, the TFR was about 2.7 both in the early 1980s and by 2017 (Hleihel, 2017). As such, in terms of fertility, we expect FSU migrants' cultural assimilation to work in the direction of having more children. This makes the FSU migration to Israel an insightful setting to study assimilation in fertility patterns as in most context the opposite is true, with immigrants' origin countries featuring greater fertility than their destination countries (see Tønnessen and Mussino, 2020; Mussino et al., 2021, for notable exceptions).

While Israeli women had significantly more children than FSU women, the average age at first birth is and was higher in Israel than in the FSU. According to UN statistics, in 2008/2009, the mean age at first birth was 27 in Israel compared to 24.6 and 25.8 for Russia and Ukraine, respectively (UN Population Division, 2012). As such, we expect cultural assimilation in this direction to push FSU immigrant women to have their first child at later ages.

Overall, prevailing fertility norms in Israel and the FSU suggest a two-dimensional assimilation pattern in *quantum* and *tempo*. For FSU immigrants, assimilating into Israeli culture would imply postponing parenthood, yet building larger families in the long run. Note that these counteracting forces imply that being able to study assimilation effects on *completed* fertility is of crucial importance. We later show evidence consistent with this point when comparing results on fertility measured at ages 35 and 39.

2.4 The Psychometric Entrance Test and Revealed Hebrew Proficiency

The Psychometric Entrance Test (PET) is a standardized test used for admissions to Israeli higher education, typically taken between the ages of 18 and 25. Crucially, PET test-takers can choose whether to take it in Hebrew or Russian (as well as Arabic, French, and English). In our empirical analysis, we interpret the decision to take the test in Hebrew as a revealed preference measure for Hebrew proficiency. This measure has two main advantages. The first is that, as opposed to self-reported, arguably noisy measures of language knowledge typically available in survey and census data (e.g., Berman et al., 2003; Bleakley and Chin, 2004, 2010; Lang and Siniver, 2009), this is a high-stakes decision with real-life consequences. Although binary, we thus expect it to carry high information content. Second, while immigrants' language proficiency is rarely observed in large-scale administrative datasets, our context allows us to precisely observe this measure for the entire population of individuals who take the PET (accounting for close to 50% of the entire sample).[7]

3 Data

We use population-level administrative data from the Israeli Population Registry between the years 1989–2019. The data allows us to observe place of birth, date of migration to Israel for those born abroad, marriage links, parent-child links, and location of residence (in 1995 and from 2000 onwards). Crucially, we can link these data to PET test-taking records, including the language in which the test was taken. Moreover, we have access to data on the self-reported level of education and occupation that FSU immigrants declared upon arrival in Israel. Lastly, we use administrative records on a time-varying measure on Israeli *resident* status to construct an out-migration variable, available for immigrants and native-born alike.[8] This is an unusually good feature of these data as individual-level information on out-migration is typically missing from large-scale administrative datasets or has to be inferred from someone "dropping out" from the data (Dustmann and Görlach, 2015).

Our main population of interest are persons who were born in the FSU and arrived in Israel in 1990 or 1991 and were between 7 and 17 years of age at the time. This amounts to about 43,000 individuals. We focus on FSU children arrived in 1990 or 1991 because for these early arrival waves, age-at-arrival is plausibly exogenous for the reasons mentioned in Sections 2 and 4. We use age 17 as the maximum age cutoff to focus on those who arrived as minors. We use the age 7 as the minimum age cutoff because this allows us to study outcomes at age 35 for all children in our data. When considering outcomes measured at age 39, we can instead analyze those who arrived between ages 11–17.

[7]This implies that results on Hebrew test-taking apply to the more educated half of our population of interest. In Appendix C we show that all of our main age-at-arrival results are similar when estimated among this subset of the population.

[8]In particular, the resident measure is constructed by the Israeli Central Bureau of Statistics as a function of time living in Israel over the past several years.

Throughout the analysis, we benchmark the outcomes of older and younger FSU child arrivals with natives of the same birth cohorts (i.e., birth years 1973–1984). Including natives in the analysis has a dual purpose: comparing age-at-arrival effects to the natives' benchmark, and accounting for secular time effects in the outcomes of interest separately from age-at-arrival effects. For natives, we focus on people who satisfy the following conditions: being born in Israel between 1973–1984, being a non-Ultra Orthodox Jew, and having parents who were not born in the FSU.

Stayers sample. We focus our analysis of long-term outcomes such as residential location, marriage, and fertility on the subset of individuals—both FSU-born and Israel-born—who are residents of Israel at age 35.[9] In other words, those for whom our out-migration dummy variable is equal to zero. Focusing on this subsample ensures that the age-at-arrival effects we estimate are not driven by differential sample attrition. Moreover, this implies that our findings on long-term outcomes should be interpreted as age-at-arrival effects conditional on staying in Israel until age 35 (Dustmann and Görlach, 2015). 95% of natives and 86% of FSU immigrants from the overall sample appear in the sample of stayers.[10]

Siblings sample. We conduct robustness tests that consist of intra-family comparisons via regression models that include mother fixed effects. For such analyses, we use the subset of our overall sample composed of individuals who have at least one sibling of the same sex. In this sample. the sibling(s) must also satisfy the sample selection conditions described above regarding age at arrival, year of arrival, and year of birth for FSU immigrants and natives.

4 Framework: Age-at-Arrival Effects

We capture age-at-arrival effects by estimating versions of the the following linear regression model, among the sample of FSU child-arrivals and natives of the same birth cohorts:

$$y_i = \sum_{k=7}^{17} \gamma_k \left(\mathbb{1}\{A_i = k\} \cdot M_i \right) + X_i' \beta + \varepsilon_i, \tag{1}$$

where M_i is a dummy variable equal to one for FSU immigrants, $\mathbb{1}\{A_i = k\}$ is a dummy variable equal to one if person i arrived in Israel at age k. The vector X_i includes birth year fixed effects that are common for immigrants and natives and account for time trends in the outcome variable y_i.

We estimate equation (1) for a variety of outcomes which fall into three broad groups. First, a dummy variable equal to one if person i chose to take the PET in Hebrew. This variable is defined for the subsample of PET test-takers (roughly half of the overall sample)

[9] As categorized by the Israeli Central Bureau of Statistics.

[10] While we lack information on the destination of those who emigrate, anecdotal accounts suggest that the most popular countries for FSU-born Israelis are the US, Canada, and Germany.

and is typically measured between ages 18–25. Second, an out-migration dummy variable equal to one if person i is not a resident of Israel at age 35. Third, outcomes measured when person i is either age 35 or 39: immigrant share in the city of residence, intermarriage, age at first child, and number of children. We study this last set of outcomes conditional on the out-migration dummy being equal to zero.

4.1 Exogeneity assumption and its link to the historical context

The parameters $\mathbf{\Gamma} \equiv \{\gamma_k\}_{k=7}^{17}$ in equation (1) represent the non-parametric conditional expectation function of y_i, relative to natives, as a function of age at arrival in Israel A_i, adjusting for time trends β. The age-at-arrival profile $\mathbf{\Gamma}$ has a causal interpretation under an assumption of no systematic differences in unobservable characteristics by age at arrival:

$$\mathbb{E}\left[\varepsilon_i | A_i = k, X_i\right] = \mathbb{E}\left[\varepsilon_i | A_i \in [7,17], X_i\right] = 0 \quad \forall \quad k = 7 \ldots 17. \tag{2}$$

This assumption is unlikely to hold in many contexts as migrant households likely internalize that the experience of international migration will affect children of different ages differently, and that the long-term economic prospects of children are also affected by age at immigration (Aloni and Avivi, 2024). As a result, children whose families decided to migrate at different ages will likely have different unobserved characteristics that potentially impact language learning and cultural integration outcomes. Under such conditions, OLS estimates of $\mathbf{\Gamma}$ would not be able to capture the causal effects of age at arrival.

However, our context is one of immigrants who can best be thought of as refugees fleeing persecution in the USSR and who left the country the moment a window of opportunity arose (Abramitzky et al., 2022). The large spike in 1990–1991 arrival numbers that followed the lifting of Soviet emigration restrictions in 1989 and preceded more stable arrival numbers throughout the 1990s (Figure A1), suggests pent-up demand to leave the USSR. It thus seems a plausible assumption that most of the immigrants in our sample left as soon as they could, with little consideration of age-at-arrival effects for their children.

Historiographical accounts share this notion of FSU Jews' urgent decision-making. Gitelman (1997), based on testimonies and interviews of migrants, writes:

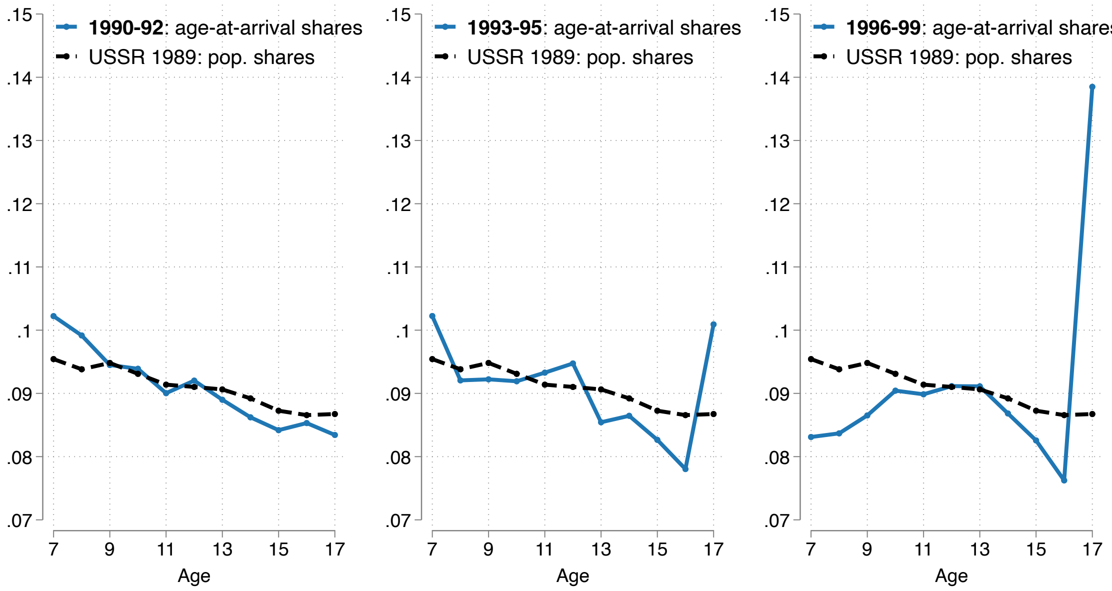
> *In 1990, 85 per cent of the largest single emigration in Russian Jewish history went to Israel. Only 31,283 Jews came to the United States and 181,759 went to Israel. Not just the destination, but the nature of the immigration, had changed again. These were not 'born again' Zionists but panicky refugees who viewed with dismay the economic deterioration of the USSR, growing ethnic strife, and the emergence of a public, virulent, grass roots anti-Semitism. This is clearly a case of 'push', rather than 'pull', driving the emigration.*

Overall, the historical context would suggest that assumption (2) is likely to hold. Sections 4.2 and 4.3 provide two pieces of empirical evidence that further suggest this is a reasonable assumption.

4.2 Comparison of child age distributions

Figure 1 compares the age distribution of children in 1989 USSR to the age distribution of FSU child immigrants arriving in Israel in 1990–92, 1993–95, and 1996–99. The goal of this comparison is to illustrate the selective migration is likely less of a concern for the early arrival waves compared to the later ones.

Figure 1: Age-at-arrival distribution by arrival cohort



Notes: Each panel represents a different arrival cohort: 1990–1992, 1993–1995, and 1996–1999. The solid line in each panel represents the age-at-arrival distribution of FSU immigrants who arrived between ages 7–17 (as share of total 7–17 year-old arrivals). The dashed line, equal across panels, represents the USSR age distribution of 7–17 year-olds in 1989 (as share of total 7–17 year-olds). Source for the USSR population is UN Population Division (2024).

The age distribution of 1990–92 child arrivals (which are the arrival cohorts Abramitzky et al. (2022) classify as refugees) is very similar to the overall Soviet age distribution. However, for the subsequent arrival cohorts, these distributions start to look quite distinct.[11] Assuming that USSR distribution represents the distribution of "potential migrants," these results would suggest that FSU immigrants in the initial period were representative of the overall pool of potential migrants and that the household decision rule to migrate was not based on children's age. This fact should lessen worries of selective migration and differences in unobserved characteristics of children arrived at different ages.

4.3 Balance: Parents' characteristics upon arrival in Israel

While assumption (2) is inherently untestable, we provide supportive empirical evidence by documenting balance in observable, predetermined characteristics. To do that, we

[11] In our analysis we focus on the 1990–91 arrival cohorts, excluding 1992, for two reasons. First, it allows us to analyze long-term outcomes at ages that are older by one year, relative to analyzing the 1992 cohort as well. Second, the exogeneity of age at arrival would be even more credible among the 1990–91 arrivals, relative to 1992 (see Figure A1 showing a distinct peak in arrivals in 1990 and 1991, which is much smaller by 1992).

leverage information from two ancillary pieces of information: FSU immigrants reporting of their level of education and occupation in the Soviet Union upon arrival to Israel, and the 1995 Israeli Census. Using these data, we show that

$$\mathbb{E}\left[Z_i|A_i = k, M_i = 1\right] = \mathbb{E}\left[Z_i|A_i \in [7, 17], M_i = 1\right] \quad \forall \quad k = 7 \ldots 17 \tag{3}$$

approximately holds for six variables Z_i: father's and mother's occupation, education, and 1995 city of residence FSU share.

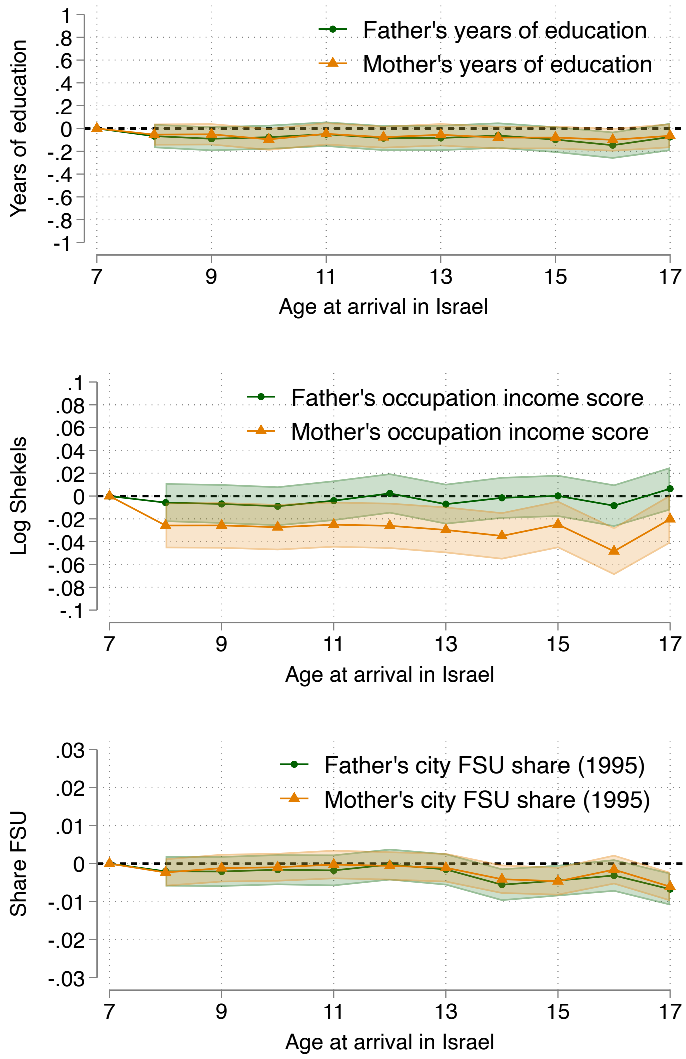
In particular, Figure 2 displays estimates of δ_k in the following linear regression, estimated among our sample of FSU child immigrants:

$$Z_i = \delta_0 + \sum_{k=8}^{17} \delta_k \cdot \mathbb{1}\{A_i = k\} + \eta_i, \tag{4}$$

where 7 is the omitted age-at-arrival category and Z_i represents i's parents' characteristics upon arrival in Israel (or in 1995 in the case of FSU city share).[12] We summarize the information contained by occupation using an income score (average income of a given occupation in Israel).

[12]The year 1995 is the first one in which we can observe city of residence, thanks to a merge between the Population Registry and the 1995 Israeli Census—the first census after the onset of the FSU immigration wave. We view balance on 1995 place of residence as a more stringent test, compared to the (unfeasible) test of balance on place of residence upon arrival in Israel. The former test implicitly shows that (i) parents of children of different ages were similar upon arrival in Israel, *and* (ii) their migration behavior during their first few years in Israel was also similar.

Figure 2: Balance: Parental education, occupation, and residential segregation



Notes: Point estimates and 95% confidence intervals of parameters δ_k in equation (4). Top subfigure: outcome variables are father's and mother's years of education. Average years of education for $A_i = 7$ are 13.8 and 13.9 for fathers and mothers, respectively. Middle subfigure: outcome variables are father's and mother's occupational income score, in logs. Bottom subfigure: outcome variables are the FSU population share in father's and mother's city of residence in 1995 (the first year in which we observe residential location). Average FSU city share for $A_i = 7$ are 0.16 for both fathers and mothers. Parental education and occupation measured at the time of arrival in Israel.

The top panel in Figure 2 shows that the education levels of the parents of children arriving in Israel at different ages were extremely similar to each other, both for fathers and mothers. Relative to the age-7 arrivals benchmark, we can rule out differences in years of education larger than 0.2 in absolute value.

The results for occupational income score on the middle panel of Figure 2 are similarly reassuring. Fathers' differentials are not statistically different from each other. While some of the mothers' age-specific estimates are statistically different from the age-7 benchmark, they are small in magnitude and remain flat as a function of age at arrival.

Lastly, the bottom panel of Figure 2 shows that the 1995 residential choices of FSU parents, measured by city FSU share, were largely indistinguishable from each other as a function of children's age at arrival.

Overall, together with the historical context and Figure 1, we interpret the evidence in Figure 2 as being consistent with assumption (2).[13] These results illustrate the usefulness of this setting to study plausibly causal age-at-arrival effects. In contrast, Åslund et al. (2023) among Yugoslav refugees in Sweden, and Connolly et al. (2023) among immigrants in Canada, document a negative relationship between age at arrival and parental education and earnings, respectively.

4.4 Sibling comparisons

As a robustness test, we will estimate different versions of the following equation that includes mother fixed effects:

$$y_i = \sum_{k=7}^{17} \gamma_k \left(\mathbb{1}\{A_i = k\} \cdot M_i \right) + X_i'\beta + \theta_{m(i)} + \varepsilon_i, \tag{5}$$

where A_i, M_i, and X_i are defined as in equation (1), $m(i)$ indexes the mother of individual i, and $\theta_{m(i)}$ are mother fixed effects. For this analysis, given that all of our estimates are gender-specific, we only consider same-sex siblings.

This approach identifies age-at-arrival effects γ_k through intra-family comparisons. That is, by comparing siblings who arrived in Israel as kids but did so at different ages. The identification assumptions in this case are less strict, as assumption (2) only needs to hold within families (Alexander and Ward, 2018). Assessing the similarity of γ_k estimated in equation (1) and γ_k estimated in equation (5) will allow us to further assess the plausibility of the identification assumption (2).

5 Results

This section presents results from estimating equation (1) when the outcome variable is (1) revealed-preference Hebrew knowledge at young adulthood, and (2) long-run cultural assimilation outcomes at ages 35 or 39. Age-at-arrival effects on Hebrew proficiency are estimated within the sample of PET test-takers, out-migration results are estimated in the full sample, and results on the remainder cultural assimilation outcomes are estimated on the sample of stayers.

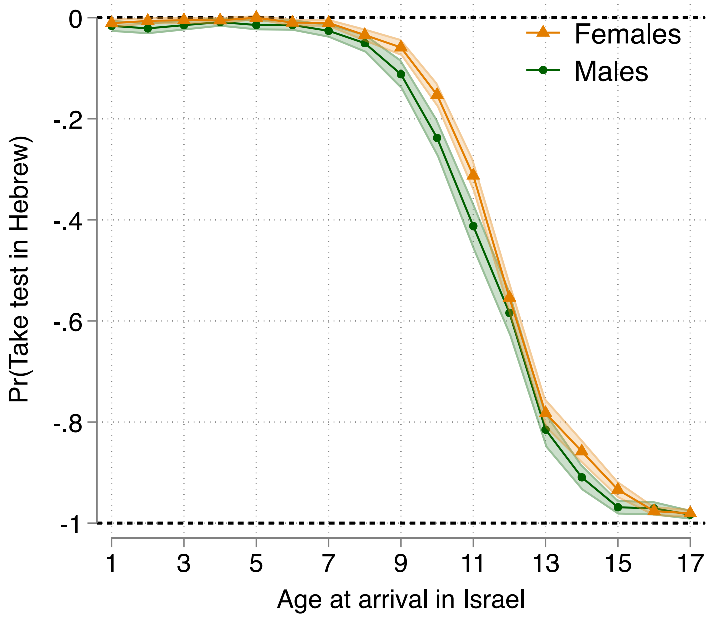
5.1 Language acquisition by young adulthood

Figure 3 shows estimates of γ_k parameters in a version of equation (1) augmented to cover ages of arrival 1–17, when y_i is equal to a dummy variable equal to one if person i took

[13] Particularly, the flat profiles in Figure 2 for FSU city share stand in sharp contrast with the corresponding profiles we document in Section 5 when measuring the same outcome for the child immigrants themselves.

the PET standardized test in Hebrew (instead of Russian or other available languages).[14]

Figure 3: Test-taking in Hebrew: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in a version of equation (1) augmented to cover ages of arrival 1–17, when outcome variable is a dummy equal to one if person i chose to take the PET university entrance standardized test in Hebrew. Estimated among the sample of PET test-takers. The probability of taking the PET test in Hebrew among natives is equal to 0.995, both for men and women.

There are three main takeaways. First, there is a strong assimilation pattern as practically all immigrants who arrived in Israel at age 7 take the test in Hebrew, while among those who arrived at age 17 the probability of doing so is close to zero.

Second, the age-at-arrival profile is non-linear, with most of the drop in probability of Hebrew test-taking occurring between arrival ages 9–14. During a few critical ages around early adolescence, language acquisition is highly sensitive to age at arrival. Instead, the specific age at arrival is not meaningful, conditional on arriving before age 8 or after age 15. This aligns with patterns documented by Bleakley and Chin (2004, 2010) in US Census data showing a flat language profile from age-at-arrival 0–7 and a decline thereafter.

Third, a clear gender gap emerges by which girls are significantly more likely than boys to take the PET test in Hebrew. The gap is particularly salient for those arriving between the critical ages of 9–15. For instance, among those who arrived at age 11, boys were 41 percentage points less likely than natives to take the exam in Hebrew, while girls were 31 percentage points less likely—a 24% differential. This is strong evidence for immigrant girls learning a second language faster than immigrant boys. Perhaps this aligns with conventional wisdom, yet systematic empirical evidence on this phenomenon is sparse (see van der Slik et al., 2015).

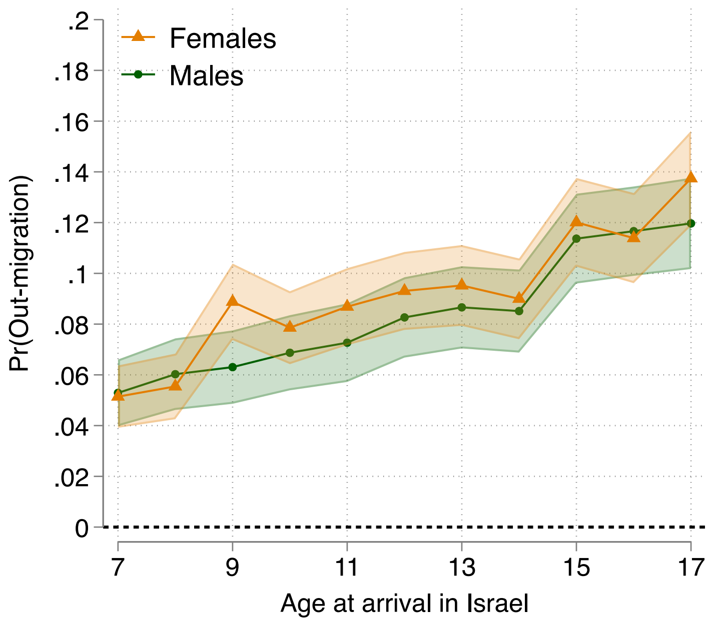
[14]We are able to cover ages of arrival 1–17 for the Hebrew language outcome as the PET is typically taken between ages 18–25. The other outcomes we study are instead measured at age 35 or 39.

Figure A4 shows that effects are very similar when estimating γ_k in equation (5), which includes mother fixed effects.

5.2 Out-migration

Figure 4 shows estimates of γ_k parameters in equation (1) when the outcome variable is a dummy equal to one if person i is no longer a resident of Israel at age 35. Among our sample, 6.3% of native men and 4.1% of native women are non-residents at age 35. Figure 4 illustrates that the immigrant-native gap features a strong, positive age-at-arrival gradient. FSU immigrants who arrived in Israel at age 7 are about 5 percentage points more likely to emigrate than natives. Instead, among those who arrived at age 17, the gap amounts to 12 and 14 percentage points for men and women, respectively. As such, arriving in Israel at age 7 compared to age 17 closes 56–63% of the gap between natives and age-17 arrivals.

Figure 4: Out-migration: Immigrant-native gap by age at arrival



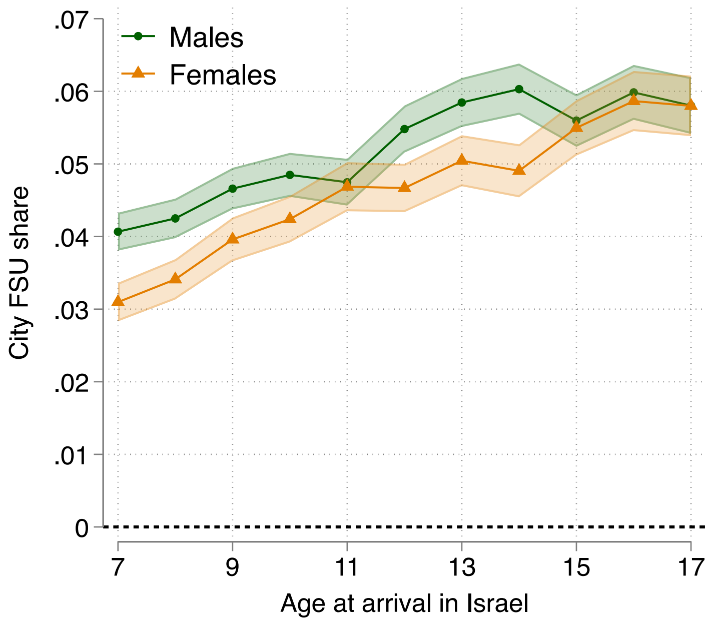
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if person i migrated out of Israel by age 35. Average out-migration probabilities among natives are 0.063 for men and 0.041 for women.

From the individual's perspective, this result arguably illustrates how those who arrive at younger ages better integrate into Israeli society, as they are less likely to make the ultimate revealed preference measure of (lack of) assimilation—leaving. From an aggregate perspective, these findings carry implications for our understanding of the life-cycle fiscal impacts of immigration (Dustmann and Frattini, 2014), since child-arrivals in our sample who outmigrate obtain much of their education in Israel, yet leave before their peak working years.

5.3 Geographical Sorting

Figure 5 shows age-at-arrival effects on geographical sorting and segregation. The outcome variable is the FSU-immigrants population share of the city where a person resides at age 35. The positive estimates throughout show that FSU child arrivals, compared to natives and regardless of age at arrival, reside by age 35 in Israeli cities with higher shares of FSU immigrants. However, the slope in Figure 5 illustrates statistically significant age-at-arrival effects. Those who arrived in Israel at ages 16–17 lived by age 35 in cities that had FSU share differentials of about 6 percentage points. Instead, those who arrived in Israel at age 7 were residing by age 35 in cities with differentials of 3 to 4 percentage points. For reference, the average FSU city share among natives is equal to 0.08. The age-at-arrival profiles are positively sloped for both genders, but steeper for women relative to men. Overall, arriving in Israel at age 7 compared to age 17 closes 30–47% of the gap between natives and age-17 arrivals.

Figure 5: FSU city share: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the FSU immigrants' population share in the city of residence of person i by age 35. Estimated among the sample of stayers. Average FSU city share among natives is 0.082 for men and 0.080 for women.

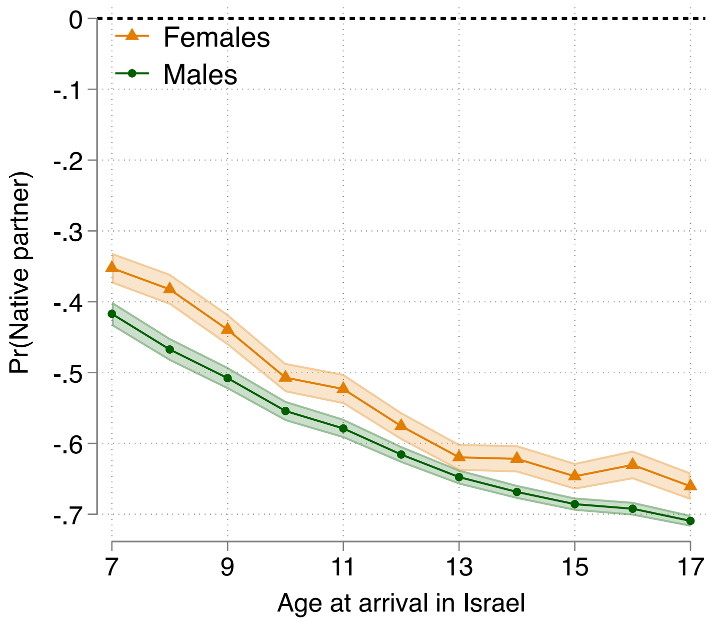
5.4 Intermarriage

Figure 6 shows age-at-arrival profiles on the probability of marrying a native. In particular, the figure shows estimates of γ_k in equation (1) when y_i is a dummy equal to one if person i has, by age 35, married an Israeli-born person.[15]

[15] Note that, as in our sample description in Section 3, this dummy is equal to one only if the marriage is to an Israeli-born person whose parents are not born in the FSU.

We see a sharp age-at-arrival profile that narrows the gap with natives for FSU children who arrived at younger ages. For instance, the differential probability of marrying a native for FSU children who arrived at age 7 is between -0.35 and -0.40, while the corresponding one for those arrived at age 17 is between -0.65 and -0.70. As benchmark, 63% of native men and 75% of native women are married to a native by age 35. Overall, arriving in Israel at age 7 compared to age 17 closes 41–47% of the gap between natives and age-17 arrivals.

Figure 6: Native spouse probability: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if person i is married to a native person by age 35, and equal to zero if married to a non-native, or single. Estimated among the sample of stayers. Probability of being married to a native by age 35 among natives is equal to 0.63 for men and 0.75 for women (without conditioning on being married).

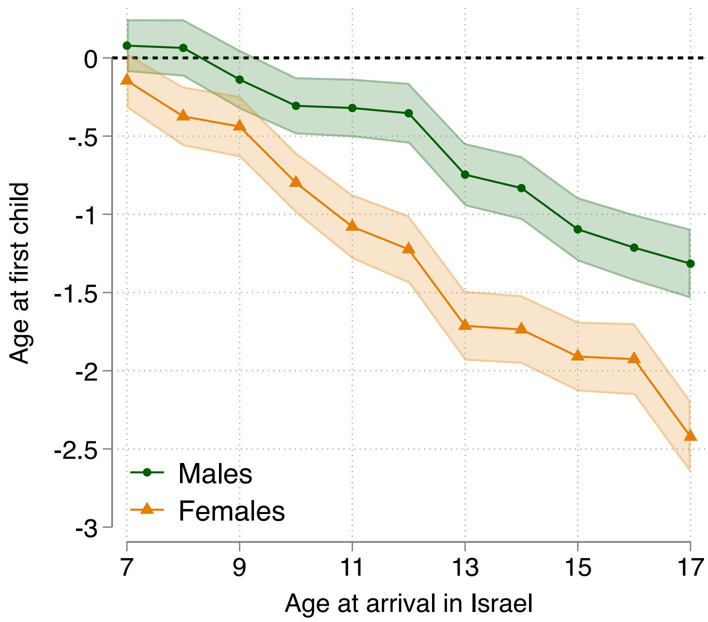
Note that the intermarriage results in Figure 6 do not condition on being married by age 35 as the outcome variable is equal to zero for those that marry other immigrants, as well as for those who are unmarried by age 35. Figure A5 shows age-at-arrival effects on the probability of being unmarried by age 35. The immigrant-native gap in the probability of being single is practically non-existent for women. Immigrant, men, instead are more likely than native men to be single, although this gap is quite constant across different arrival ages.

5.5 Fertility: *Tempo* and *quantum*

As outlined in Section 2.3, the Soviet norm compared to the Israeli one was to start having children at a younger age, but having a lower number of children in total. As such, assimilation would predict that greater exposure to the local norms would drive FSU immigrants to have their first child at older ages (*tempo*) but have more children over their lifetimes (*quantum*).

Figure 7 displays age-at-arrival effects for age at first birth (conditional on having at least one child). There is a strong age-at-arrival gradient which is particularly steep for women. FSU female immigrants who arrived at age 17 had their first child, on average, about 2.5 years before natives. FSU men who arrived at age 17 similarly had their first child about 1.25 years before their native counterparts. However, Figure 7 shows full convergence for age-7 arrivals. Among this group, the average age at first child is indistinguishable from that of natives.

Figure 7: Age at first child: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the age at first child (left panel). Estimated among the sample of stayers and conditioning on having at least one child. Average age at first child among natives is 29.9 for men and 28.1 for women.

While Figure 7 shows evidence of assimilation on the fertility *tempo* margin, Figures 8 and 9 show similar evidence on *quantum*.

Figure 8 shows age-at-arrival effects when the outcome variable is the total number of children. A common empirical challenge in studies of determinants of fertility is that it is often unfeasible to measure *completed* fertility. Our setting allows us to study age-at-arrival effects by age 39—when most women have indeed completed fertility. Moreover, we are able to illustrate the importance of studying age 39 in contrast with age 35, especially because the *tempo* effects illustrated on Figure 7 work in the direction of attenuating any assimilation effects on *quantum*.[16]

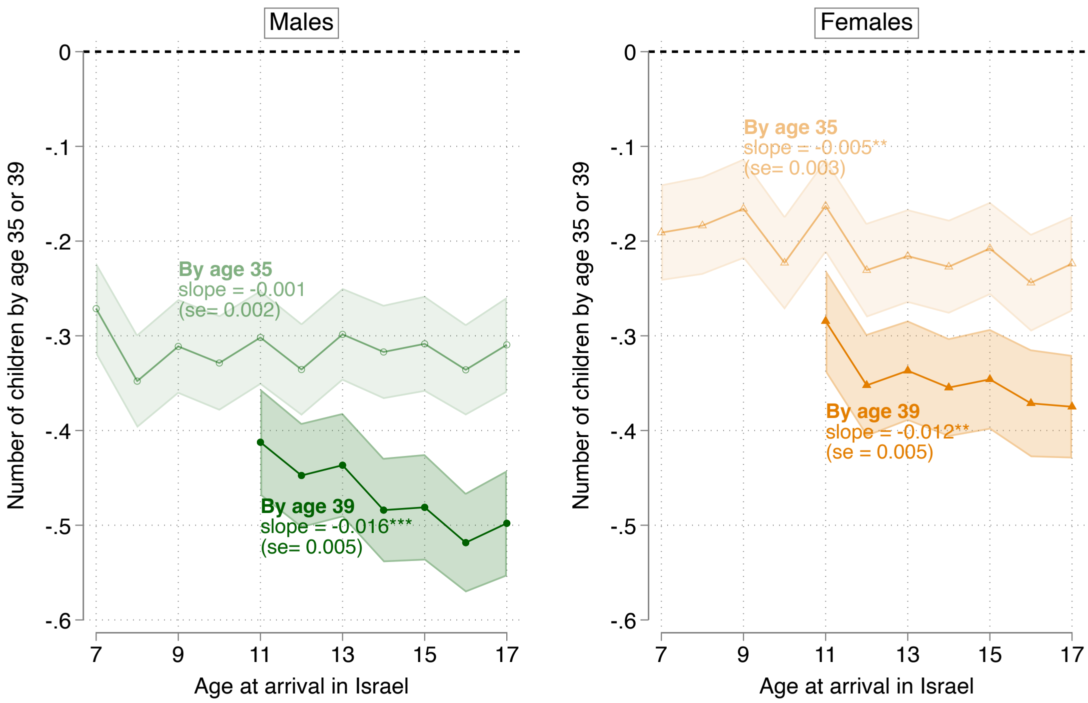
The left panel of Figure 8 shows that, by age 35, male FSU immigrants had an average of about 0.3 fewer children than natives. However, there is no sign of assimilation as the gap

[16]That is, Figure 7 illustrates how immigrants who arrive earlier start having children at *older* ages. Hence, any assimilation effects in the direction of younger arrivals having *more* children will be muted if the number of children is measured at a too early age.

is constant across arrival ages. However, by age 39, a clear assimilation pattern arises: those who arrived at age 11 feature a -0.4 gap with natives, while for those who arrived at age 17, the gap is equal to -0.5. Estimating a linear age-at-arrival gradient results in an estimate of -0.016 (standard error = 0.005). Extrapolating this linear trend would imply that arriving in Israel at age 7, compared to age 17, closes 32% of the male gap between natives and age-17 arrivals.

For women, who start having children at younger ages, the right panel of Figure 8 shows that signs of assimilation already arise by age 35. At this age, the gap in the number of children is slightly greater for age-17 arrivals than age-7. We estimate a subtle linear age-at-arrival gradient by age 35 that is equal to -0.005, statistically significant at the 5% level. However, the assimilation pattern becomes more evident by age 39, where the gaps with natives for age-11 and age-17 arrivals are equal to -0.28 and -0.37, respectively. The linear gradient now more than doubles and is equal to -0.012 (standard error=0.005). Extrapolating this linear trend would imply that arriving in Israel at age 7, compared to age 17, closes 31% of the female fertility gap between natives and age-17 arrivals.

Figure 8: Number of children by ages 35 and 39: Immigrant-native gap by age at arrival

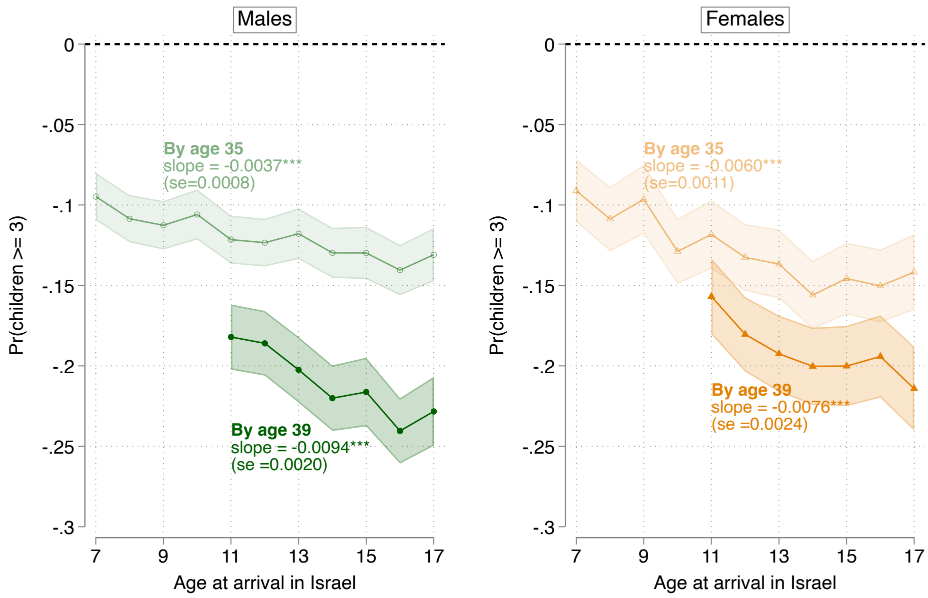


Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the total number of children by age 35 or by age 39. Estimated among the sample of stayers. Average number of children by age 35 among natives is 1.56 for men and 2.02 for women. Average number of children by age 39 among natives is 2.03 for men and 2.40 for women. Results do not condition on having at least one child. The figure also reports the age-at-arrival coefficient estimates and standard errors of a version of equation (1) with linear age-at-arrival effects. * p<0.10, ** p<0.05, *** p<0.01.

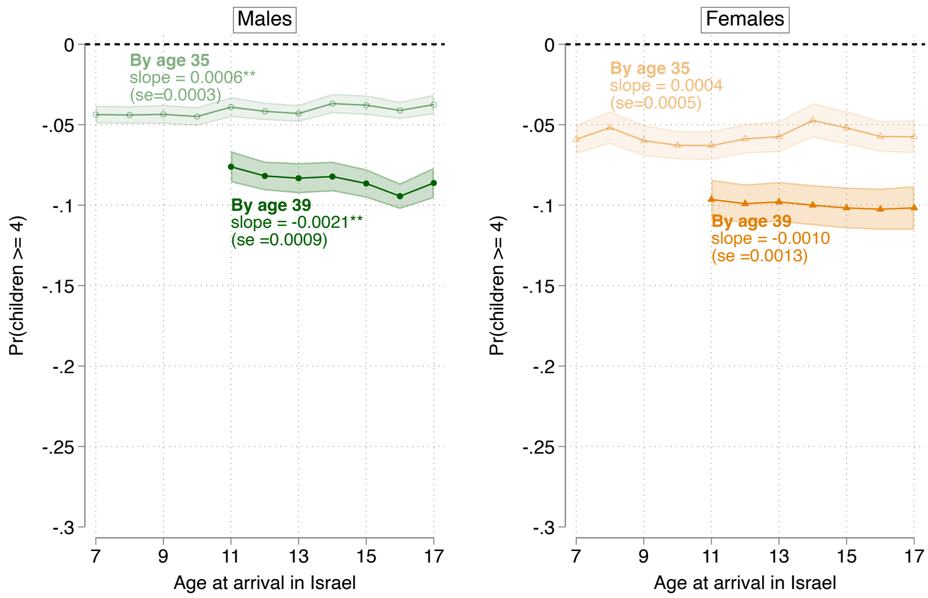
We now go beyond the mean and examine age-at-arrival effects on the probability of reaching high levels of fertility. Figure 9 shows estimates of γ_k parameters in a equation (1) for two outcome variables: a dummy variables that are equal to one if a person has three or more children (top panel) or four or more children (bottom panel).

Figure 9: Probability of high fertility: Immigrant-native gap by age at arrival

(a) Probability of number of children ≥ 3



(b) Probability of number of children ≥ 4



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has 3 or more children (top panel) or 4 or more children (bottom panel). Estimated for number of children by age 35 and by age 39. Sample of stayers. The probabilities among male natives of having 3+ children are 0.21 (by age 35) and 0.40 (by age 39). The probabilities among female natives of having 3+ children are 0.35 (by age 35) and 0.52 (by age 39). The probabilities among male natives of having 4+ children are 0.05 (by age 35) and 0.11 (by age 39). The probabilities among female natives of having 4+ children are 0.09 (by age 35) and 0.16 (by age 39). The figure also reports the age-at-arrival coefficient estimates and standard errors of a version of equation (1) with linear age-at-arrival effects. * p<0.10, ** p<0.05, *** p<0.01.

The results in the top panel of Figure 9 show, for both men and women, a clear assimilation trend in the probability of having three children or more that is already detectable by age 35 and becomes more salient by age 39. The estimated linear age-at-arrival gradient implies that age-7 arrivals close 41% and 35% of the age-17 gap with natives, for men and women, respectively.

The bottom panel of Figure 9 shows that all of the age-at-arrival action on the probability of having 3 or more children comes from having precisely 3. There is a large gap with natives in the probability of having four or more children, which amounts to 63–73% of the corresponding probability for natives (0.11 and 0.16 of native men and women, respectively, have four or more children by age 39). However, this gap is mostly constant across arrival ages (the age-39 slope for men is small, yet statistically significant and consistent with assimilation). It thus seems that any assimilation effects on high-fertility behavior that occur between ages of arrival 7–17 do not reach the probability of having four children or more.

Figures A7 and B5 provide additional evidence on age-at-arrival effects across the distribution of the number of children by age 35 and 39, respectively. In particular, each of the panels in these figures show age-at-arrival effects on the probability of having 0, 1, 2, 3, and 4 or more children by age 35 or 39.[17] The starkest assimilation pattern in terms of age-at-arrival gradient is the one for the probability of having three children.

Overall, we interpret the results on completed fertility as indicative of salient age-at-arrival effects that reflect exposure to the Israeli high-fertility norm. This cultural assimilation interpretation is strengthened by the fact that the positive effects on the number of children are driven by the probability of having three children. Recall from Section 2.3 that the total fertility rate in what is now Russia and Ukraine was close to two during the 1980s, while in Israel it was around three.

5.6 Robustness

5.6.1 Intra-family comparisons

Tables A1 and A2 show estimates from a linear version of equation (5), comparing unconditional age-at-arrival profiles with age-at-arrival profiles that condition on mother fixed effects. This analysis estimates age-at-arrival profiles exclusively comparing siblings of the same sex who arrived in Israel from the FSU at different ages. At such, it relaxes our identification assumption (2). The results are reassuring as estimates of the age-at-arrival gradient with and without mother fixed effects are largely similar.

5.6.2 Measuring outcomes by age 39

Appendix B includes figures showing our main results when instead of measuring long-term outcomes at age 35, we do so at age 39. The main benefit of using age 39 is that we have a better picture of completed fertility than when using age 35. The drawback is that we are constrained to analyze age-at-arrival effects between ages 11–17, rather than 7–17

[17] Figures A8 and B6 show, instead, effects on the probability of having 1 or more, 2 or more, 3 or more, and 4 or more children by ages 35 and 39, respectively.

as we do for age-35 outcomes. In any case, the 11–17 age-at-arrival effects estimated using age-39 outcomes deliver similar conclusions to those using age-35 (with the exception of the number of children, as discussed above).

5.6.3 Results on the sample of PET test takers

Appendix C shows that results are largely similar and conclusions remain unchanged when we estimate all our effects among the subsample of PET test takers only—i.e., those for whom we can observe our revealed-preference measure of Hebrew knowledge. This is the subset of individuals who enter our results on language acquisition (Figure 3) and the mediation analysis in Section 6.

6 Mediation Role of Hebrew Proficiency

How determinant is local language proficiency as a vehicle toward long-run cultural integration? How much of the integration effects of arriving at a younger age are channeled through a higher probability of mastering the local language? To gauge the mediating role of Hebrew knowledge in age-at-arrival effects, we estimate different versions of the following linear regression models:

$$y_i = \gamma \left(A_i \cdot M_i\right) + \delta M_i + X_i' \beta + \varepsilon_i, \tag{6}$$

and:

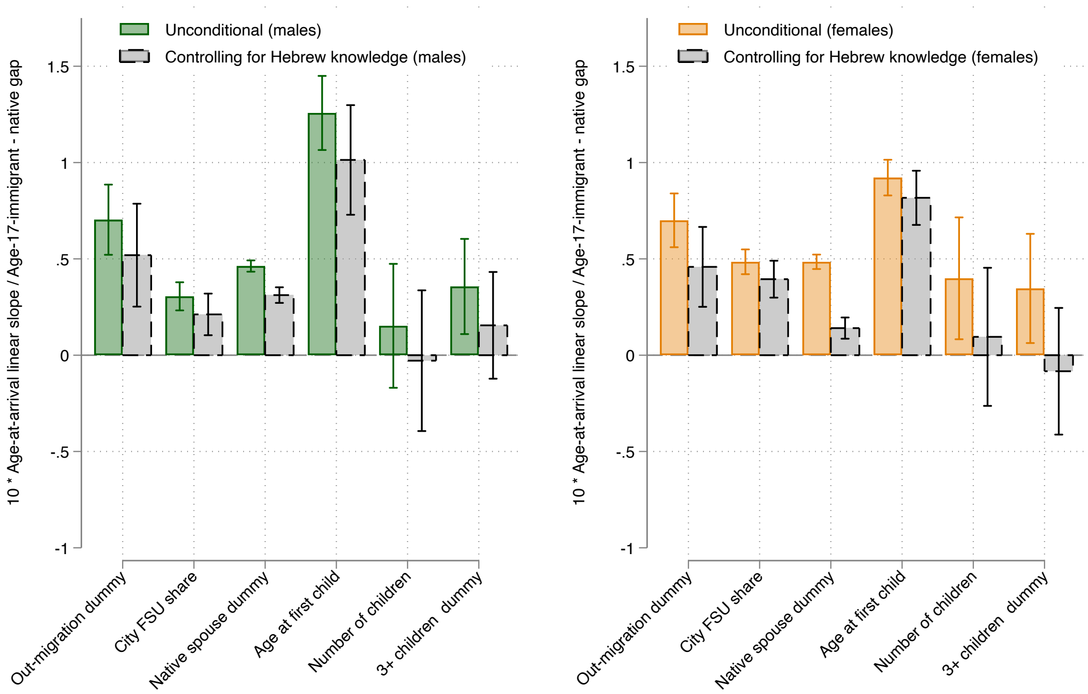
$$y_i = \gamma^H \left(A_i \cdot M_i\right) + X_i' \beta^H + \delta_0 M_i + \delta_1 H_i + \delta_2 H_i \cdot M_i + \nu_i, \tag{7}$$

where y_i, M_i, and X_i are defined as in equation (1), and H_i is a dummy variable equal to one if person i took the PET test in Hebrew. Given that we only observe H_i among PET test-takers, in this section we estimate equations (6) and (7) using only that subsample.

While γ represents unconditional linear age-at-arrival effects, the parameter γ^H instead adjusts for the fact that FSU immigrants who arrived younger are much more likely to learn Hebrew than those who arrived older. To the extent that the age-at-arrival profile γ^H is flatter than the profile γ, this would be consistent with Hebrew knowledge being a mediator of age-at-arrival cultural assimilation effects.

Figure 10 below plots estimates and 95% confidence intervals of γ and γ^H from equations (6) and (7), for different outcome variables y_i. In particular, to ease the comparison of magnitudes across outcomes, the figure represents $\frac{10\hat{\gamma}}{\hat{\delta}+17\hat{\gamma}}$ and $\frac{10\hat{\gamma}^H}{\hat{\delta}+17\hat{\gamma}}$ for each of six outcome variables, where $\hat{\delta} + 17\hat{\gamma}$ is the gap between natives and immigrants who arrived at age 17. As such, the magnitudes in Figure 10 can be interpreted as the effect of a 10-year younger arrival age in Israel, normalized by the native-vs-age-17 arrivals gap.

Figure 10: Hebrew proficiency mediation: Age-at-arrival profiles, baseline and controlling for Hebrew test-taking



Notes: Point estimates and 95% confidence intervals (robust standard errors) of $\frac{10\gamma}{\delta+17\gamma}$ and $\frac{10\gamma^H}{\delta+17\gamma}$, where γ, δ, and γ^H are parameters in equations (6), and (7). Normalization is such that the figure is measured in units of the immigrant-native gap among age-17 arrivals ($\delta + 17\gamma$) and captures the effect of a 10-year difference in age at arrival. Outcome variables are indicated on the horizontal axis. *Number of children* and *3+ children dummy* outcomes are measured by age 39, with age-at-arrival effects estimated using ages 11–17; all other outcomes are measured by age 35, with age-at-arrival effects estimated using ages 7–17. Out-migration outcome: Estimated among the sample of PET test-takers. Other outcomes: Estimated among the sample of PET test-taker stayers.

The main takeaway from Figure 10 is that, across cultural assimilation outcomes, adjusting for Hebrew knowledge meaningfully moderates age-at-arrival gradients. Age-at-arrival effects on the probability of out-migration, FSU city share, and the probability of intermarriage are substantially reduced, in some cases by 50 percent or more. When looking at fertility outcomes such as number of children and the probability of having three or more children, estimates of γ^H are not statistically different from zero, in spite of the age gradients we estimate when not controlling for Hebrew (particularly so for the probability of having 3+ children). Estimates $\hat{\gamma}^H$ for age at first child are also smaller than $\hat{\gamma}$, but the difference in magnitude is not very big.

Overall, we interpret these results as indicating that the stark age-at-arrival patterns on Hebrew language learning documented in Figure 3 play an important mediating role in long-term cultural assimilation outcomes. This suggests that, in contexts where policy makers might wish to predict the long-term assimilation prospects of child immigrants, knowledge of the local language could be a substitute for younger ages at arrival.

7 Conclusion

This paper shows how age at arrival shapes the long-run cultural assimilation of child immigrants, leveraging a unique historical context providing arguably exogenous variation in age at immigration, together with rich register data that allows us to track immigrants for almost three decades. We propose a novel, high-stakes revealed-preference indicator of language acquisition—the language chosen to take the university entrance standardized test—which has the additional advantage of being accurately recorded in the administrative data we use.

Even small differences in the age at arrival of immigrant children can have long-lasting integration effects. Arriving just a few years earlier can markedly increase the probability of adopting the host-country language, remaining in Israel, living outside immigrant enclaves, marrying a native, and converging to native fertility norms. Language seems particularly sensitive around a narrow set of ages in early adolescence, and girls seem to have an easier time learning the new language, relative to boys. Mediation analysis evidence shows that proficiency in the local language plays an important role in immigrants' subsequent integration in terms of family formation and fertility.

From an immigration policy perspective, the findings provide causal evidence that admitting immigrant families at younger child ages—or ensuring that older children arrive with host-language skills—leads to greater cultural integration in the long run. Governments concerned about cultural mismatch, demographic aging, and fiscal sustainability could consider policies that promote the arrival of immigrant families with such traits.

Finally, the FSU-Israel setting illustrates that exposure to a high-fertility cultural norm can increase fertility. While existing literature illustrates how culture and social norms may depress fertility, our evidence indicates that cultural transmission can also operate in the opposite direction: earlier-arriving children, more exposed to Israel's high fertility culture, tend to have larger families. These findings may inform ongoing policy discussions about the demographic and economic challenges posed by declining global fertility (Jones, 2022).

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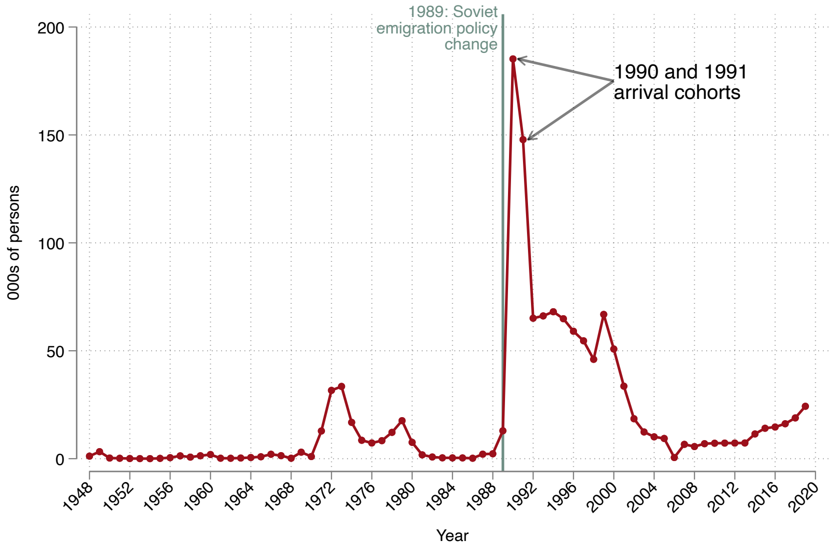
- SUPPLEMENTARY APPENDICES -
For Online Publication Only

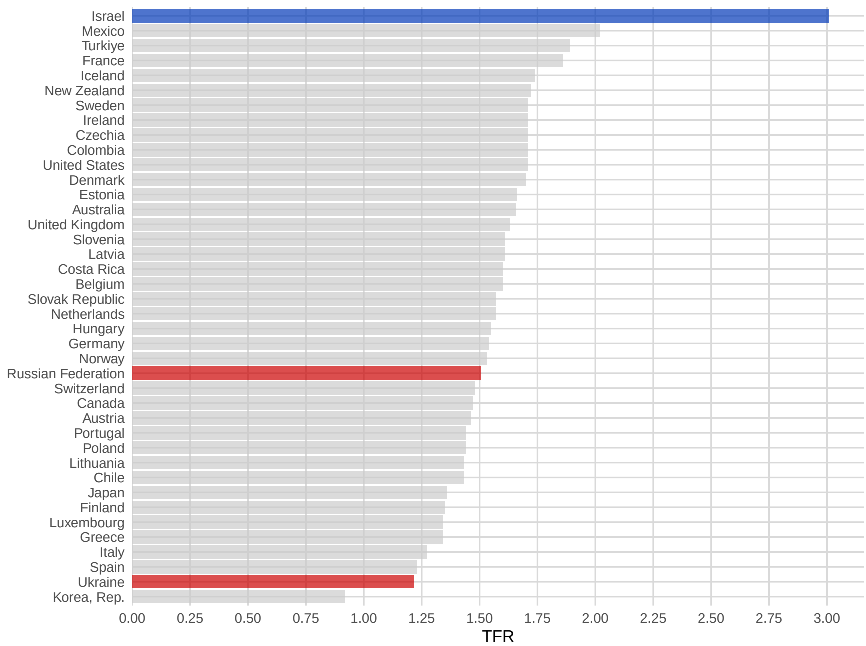
A Additional Figures and Tables

Figure A1: FSU Immigration to Israel



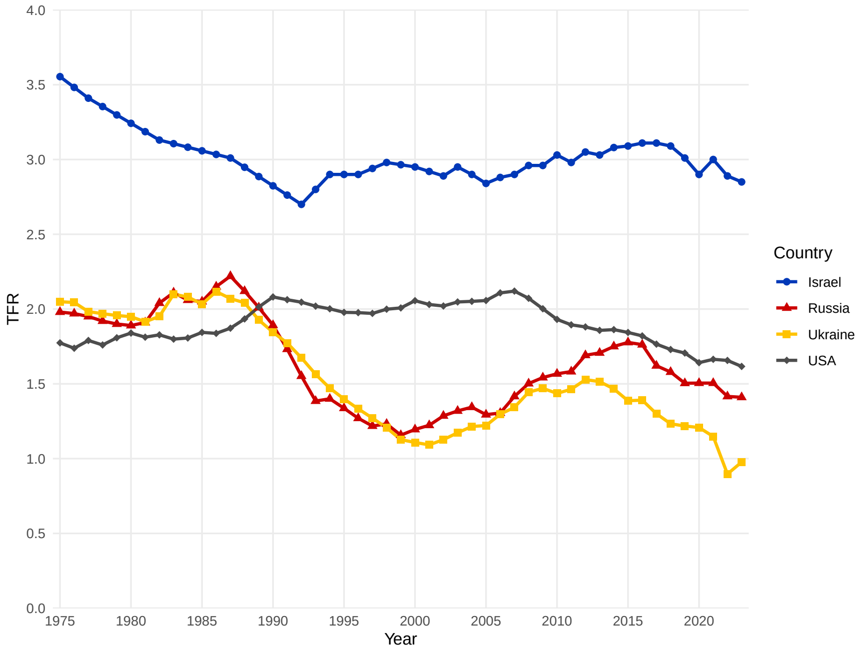
Notes: Number of immigrants arriving in Israel from the former Soviet Union, by year. The 1990 and 1991 arrival cohorts are the ones that comprise our analysis sample. Source: Israel Central Bureau of Statistics.

Figure A2: Total Fertility Rate: OECD, Russia, and Ukraine (2019)



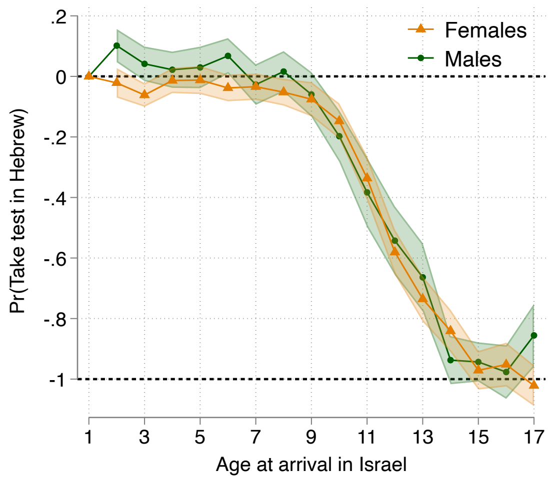
Notes: Total fertility rate in 2019 among OECD countries, Russia, and Ukraine. Source: World Development Indicators, World Bank.

Figure A3: Total Fertility Rate 1975-2023



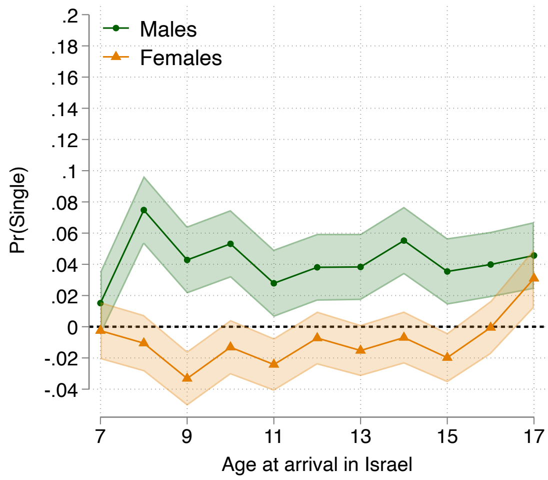
Notes: Total fertility rate 1975–2023 in Israel, Russia, Ukraine, and USA. Source: World Development Indicators, World Bank.

Figure A4: Hebrew test-taking: Age-at-arrival effects with mother fixed effects



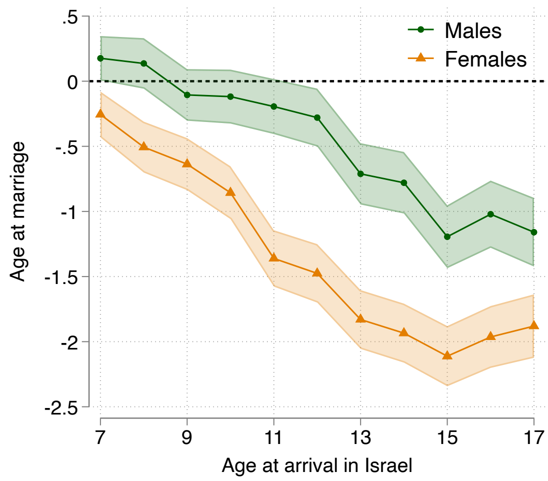
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in a version of equation (5) augmented to cover ages of arrival 1–17, when outcome variable is a dummy equal to one if person i chose to take the PET university entrance standardized test in Hebrew. Estimated among the sample of PET test-takers in the siblings sample. The probability of taking the PET test in Hebrew among age-1 arrivals is equal to 0.975 for men and 0.983 for women.

Figure A5: Single status: Immigrant-native gap by age at arrival



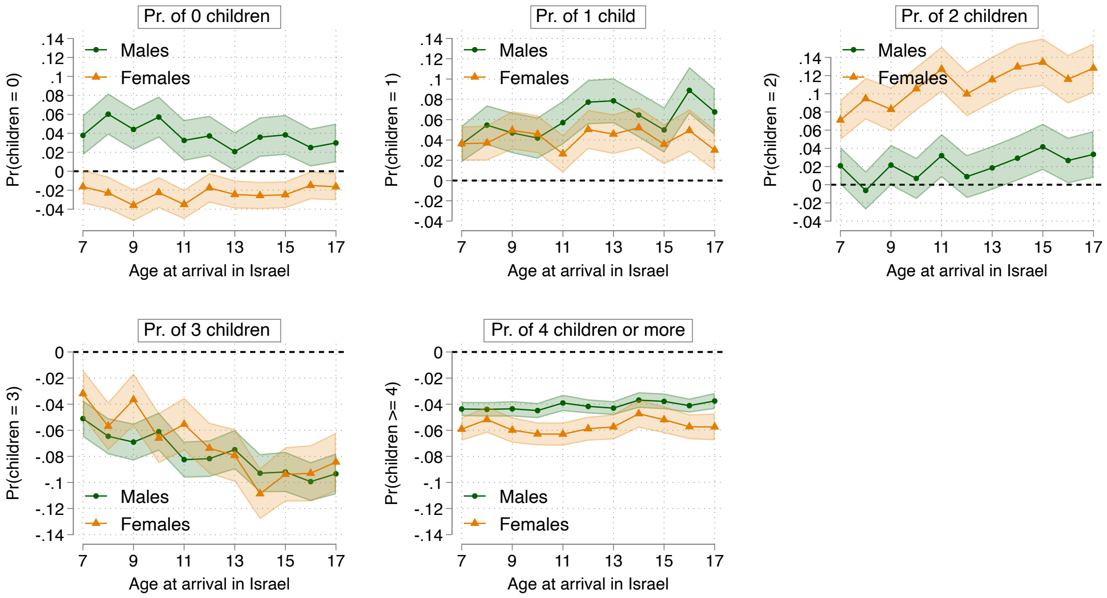
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if person i is unmarried by age 35, and equal to zero if married. Estimated among the sample of stayers. Probability of being single by age 35 among natives is equal to 0.26 for men and 0.17 for women.

Figure A6: Age at marriage: Immigrant-native gap by age at arrival



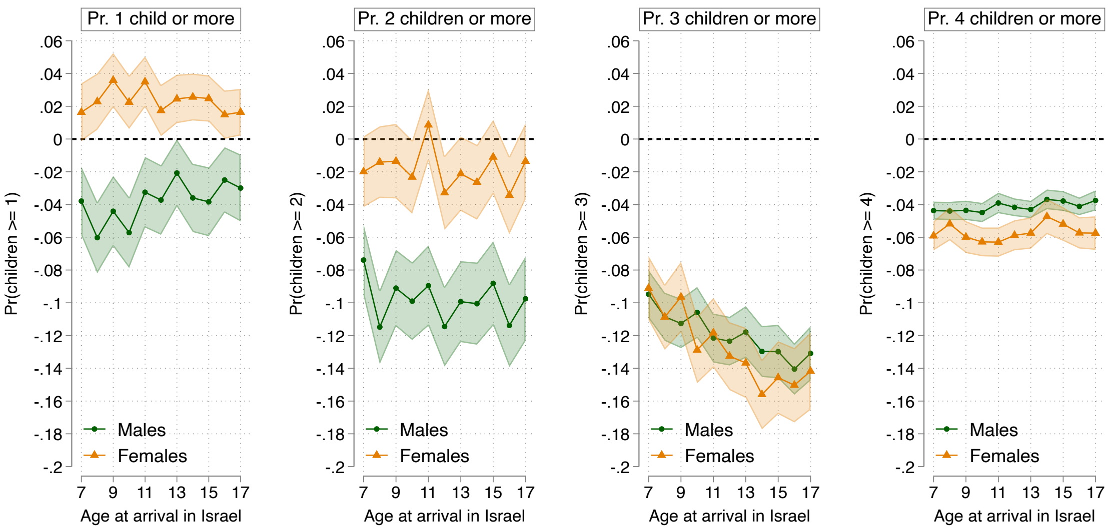
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is age at (first) marriage. Estimated among the sample of married stayers. Average age of (first) marriage among natives is equal to 28.2 for men and 26.2 for women.

Figure A7: Total number of children distribution: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 35, where n is equal to 0, 1, 2, 3, or 4+. Estimated among the sample of stayers. The probabilities among male natives for having 0, 1, 2, 3, or 4+ children by age 35 are 0.27, 0.19, 0.33, 0.16, and 0.05, respectively. The probabilities among female natives for having 0, 1, 2, 3, or 4+ children by age 35 are 0.16, 0.14, 0.35, 0.26, and 0.09, respectively.

Figure A8: Total number of children CDF: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 35, where n is equal to 1+, 2+, 3+, or 4+. Estimated among the sample of stayers. The probabilities among male natives for having 1+, 2+, 3+, or 4+ children by age 35 are 0.73, 0.54, 0.21, and 0.05, respectively. The probabilities among female natives for having 1+, 2+, 3+, or 4+ children by age 35 are 0.84, 0.70, 0.35, and 0.09, respectively.

Table A1: Age-at-arrival profiles, with and without mother fixed effects - Males

	Out-migration		City FSU share		Native spouse		Age at first child		Number of children		3+ children	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age at arrival	0.0046	0.0023	0.0023	0.0016	-0.0309	-0.0315	-0.1469	-0.1707	0.0021	-0.0001	-0.0035	-0.0003
	(0.0016)	(0.0014)	(0.0004)	(0.0003)	(0.0014)	(0.0014)	(0.0208)	(0.0206)	(0.0054)	(0.0050)	(0.0018)	(0.0017)
Mother FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	113,707	112,512	106,849	101,246	106,821	101,200	84,157	67,420	106,849	101,246	106,849	101,246

Notes: Point estimates and robust standard errors of linear age-at-arrival effects γ in equation (5), with and without mother fixed effects. Out-migration outcome: Estimated among the siblings sample. All other outcomes: Estimated among the stayers siblings sample. All outcomes are measured by age 35.

Table A2: Age-at-arrival profiles, with and without mother fixed effects - Females

	Out-migration		City FSU share		Native spouse		Age at first child		Number of children		3+ children	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age at arrival	0.0078	0.0065	0.0029	0.0024	-0.0354	-0.0329	-0.2099	-0.1693	-0.0089	-0.0208	-0.0067	-0.0094
	(0.0017)	(0.0014)	(0.0004)	(0.0003)	(0.0024)	(0.0022)	(0.0226)	(0.0206)	(0.0057)	(0.0050)	(0.0025)	(0.0023)
Mother FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	109,682	109,237	105,413	102,122	105,390	102,083	91,449	80,216	105,413	102,122	105,413	102,122

Notes: Point estimates and robust standard errors of linear age-at-arrival effects γ in equation (5), with and without mother fixed effects. Out-migration outcome: Estimated among the siblings sample. All other outcomes: Estimated among the stayers siblings sample. All outcomes are measured by age 35.

Table A3: Age-at-arrival profiles, with and without controlling for Hebrew knowledge - Males

	Out-migration		City FSU share		Native spouse		Age at first child		Number of children		3+ children	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age at arrival	0.0085	0.0062	0.0019	0.0013	-0.0344	-0.0232	-0.1554	-0.1252	0.0001	0.0056	-0.0034	-0.0016
	(0.0011)	(0.0016)	(0.0002)	(0.0003)	(0.0011)	(0.0015)	(0.0121)	(0.0179)	(0.0035)	(0.0051)	(0.0011)	(0.0016)
Hebrew control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	109,889	109,889	102,743	102,743	102,712	102,712	80,117	80,117	102,743	102,743	102,743	102,743

Notes: Point estimates and robust standard errors of linear age-at-arrival effects γ in equation (6) (unconditional on Hebrew knowledge; odd columns) and γ^H in equation (7) (conditional on Hebrew knowledge; even columns). Out-migration outcome: Estimated among the siblings sample. All other outcomes: Estimated among the sample of PET test-takers. All outcomes are measured by age 35.

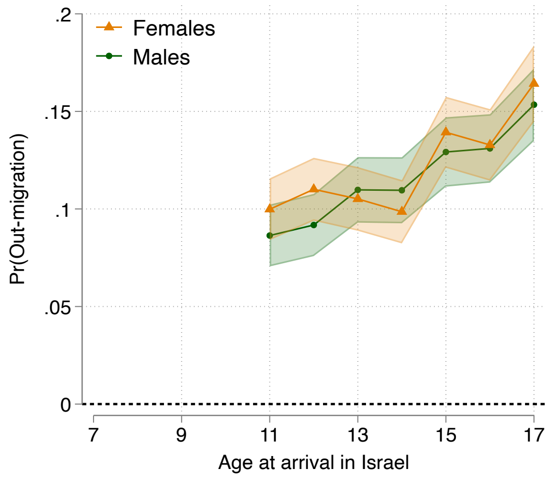
Table A4: Age-at-arrival profiles, with and without controlling for Hebrew knowledge - Females

	Out-migration		City FSU share		Native spouse		Age at first child		Number of children		3+ children	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Age at arrival	0.0096	0.0063	0.0032	0.0026	-0.0338	-0.0098	-0.2218	-0.1966	-0.0050	0.0053	-0.0042	0.0030
	(0.0010)	(0.0015)	(0.0002)	(0.0003)	(0.0013)	(0.0020)	(0.0114)	(0.0173)	(0.0031)	(0.0046)	(0.0013)	(0.0020)
Hebrew control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	140,257	140,257	133,461	133,461	133,423	133,423	115,298	115,298	133,461	133,461	133,461	133,461

Notes: Point estimates and robust standard errors of linear age-at-arrival effects γ in equation (6) (unconditional on Hebrew knowledge; odd columns) and γ^H in equation (7) (conditional on Hebrew knowledge; even columns). Out-migration outcome: Estimated among the siblings sample. All other outcomes: Estimated among the sample of PET test-takers. All outcomes are measured by age 35.

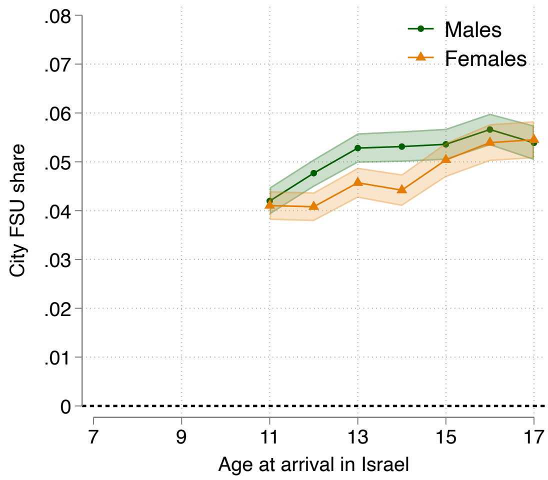
B Results for Long-term Outcomes Measured at Age 39

Figure B1: Out-migration by age 39: Immigrant-native gap by age at arrival



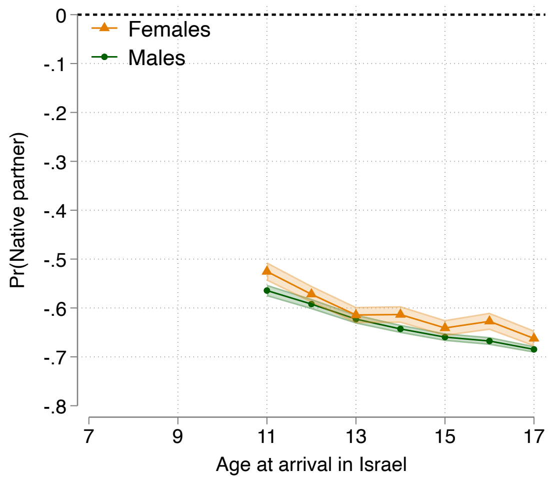
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if person i migrated out of Israel by age 39. Average out-migration probabilities among natives are 0.068 for men and 0.045 for women.

Figure B2: FSU city share at age 39: Immigrant-native gap by age at arrival



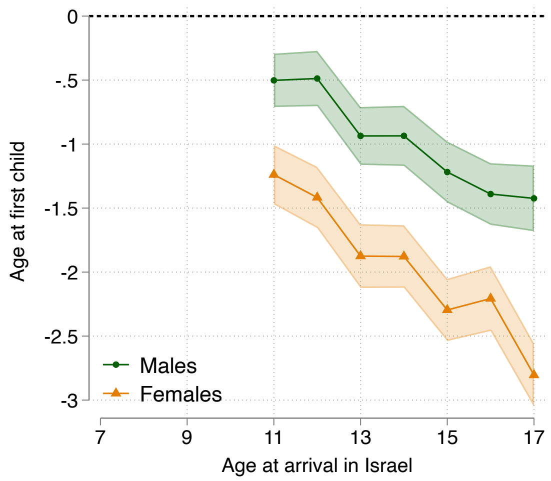
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the FSU immigrants' population share in the city of residence of person i by age 39. Estimated among the sample of stayers. Average FSU city share among natives is 0.076 for men and 0.074 for women.

Figure B3: Native spouse probability by age 39: Immigrant-native gap by age at arrival



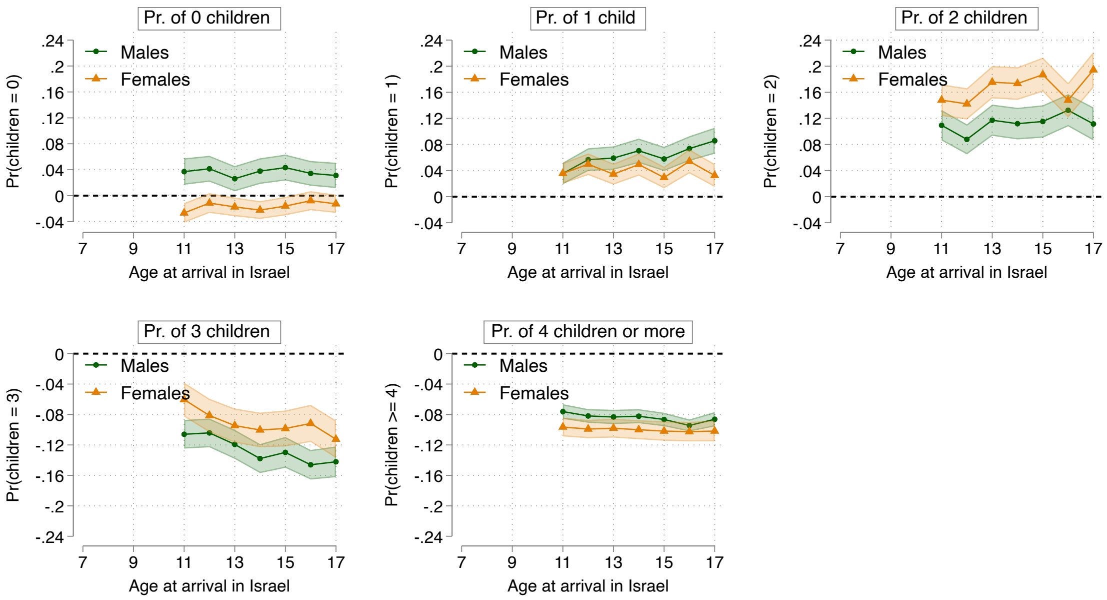
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if married to a native person by age 39. Estimated among the sample of stayers. Probability of native partner among natives is equal to 0.67 for men and 0.77 for women.

Figure B4: Age at first child by age 39: Immigrant-native gap by age at arrival



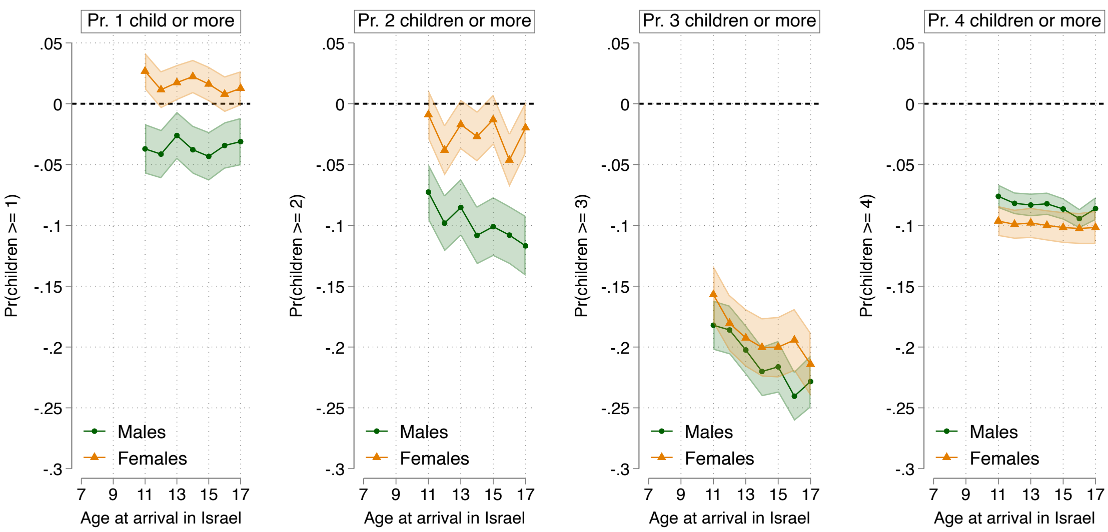
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the age at first child. Estimated among the sample of stayers. Average age at first child among natives is 30.8 for men and 28.6 for women. Results condition on having at least one child.

Figure B5: Number of children by age 39 distribution: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 39, where n is equal to 0, 1, 2, 3, or 4+. Estimated among the sample of stayers. The probabilities among male natives for having 0, 1, 2, 3, or 4+ children by age 39 are 0.21, 0.10, 0.28, 0.29, and 0.11, respectively. The probabilities among female natives for having 0, 1, 2, 3, or 4+ children by age 39 are 0.13, 0.08, 0.27, 0.36, and 0.16, respectively.

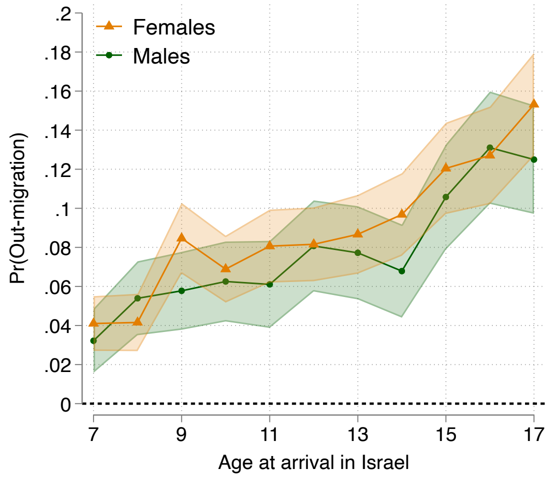
Figure B6: Number of children by age 39 CDF: Immigrant-native gap by age at arrival



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 39, where n is equal to 1+, 2+, 3+, or 4+. Estimated among the sample of stayers. The probabilities among male natives for having 1+, 2+, 3+, or 4+ children by age 39 are 0.79, 0.68, 0.40, and 0.11, respectively. The probabilities among female natives for having 1+, 2+, 3+, or 4+ children by age 39 are 0.87, 0.79, 0.52, and 0.16, respectively.

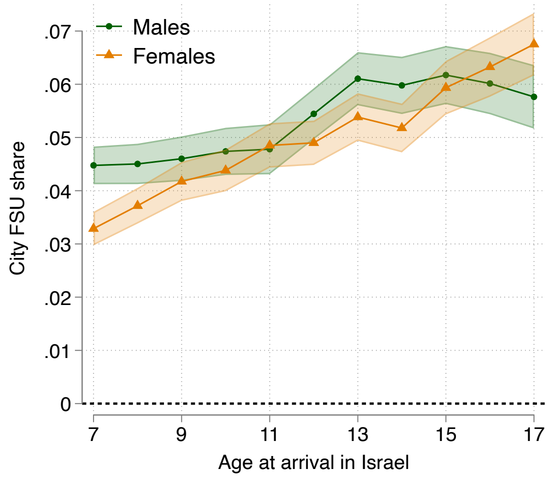
C Results for the sample of PET test-takers

Figure C1: Out-migration: Immigrant-native gap by age at arrival, sample of PET test-takers



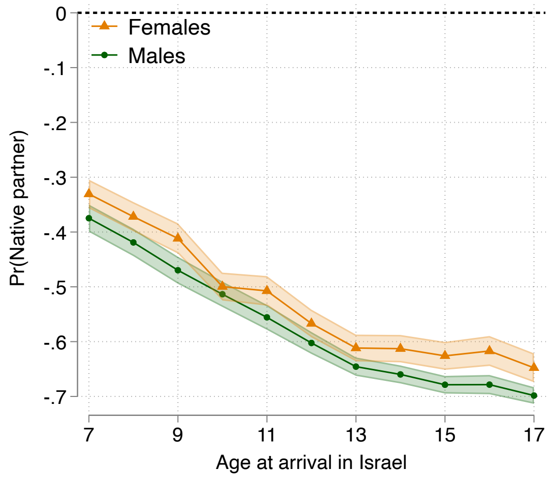
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if person i migrated out of Israel by age 35. Estimated among the sample of PET test-takers. Average out-migration probabilities among natives are 0.063 for men and 0.041 for women.

Figure C2: FSU city share: Immigrant-native gap by age at arrival, sample of PET test-takers



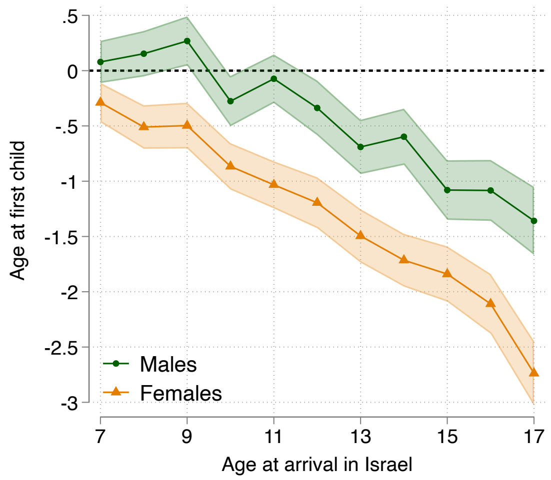
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the FSU immigrants' population share in the city of residence of person i by age 35. Estimated among the sample of PET test-taking stayers. Average FSU city share among natives is 0.082 for men and 0.080 for women.

Figure C3: Native spouse probability: Immigrant-native gap by age at arrival, sample of PET test-takers



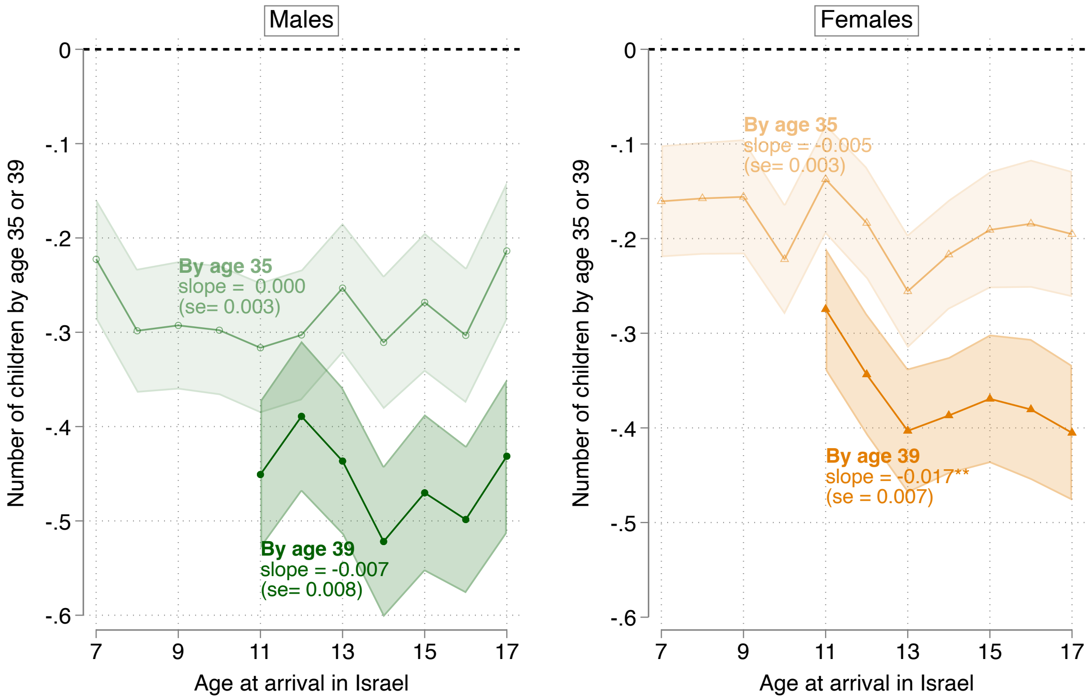
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if married to a native person by age 35. Estimated among the sample of PET test-taking stayers. Probability of native partner among natives is equal to 0.63 for men and 0.75 for women.

Figure C4: Age at first child: Immigrant-native gap by age at arrival, sample of PET test-takers



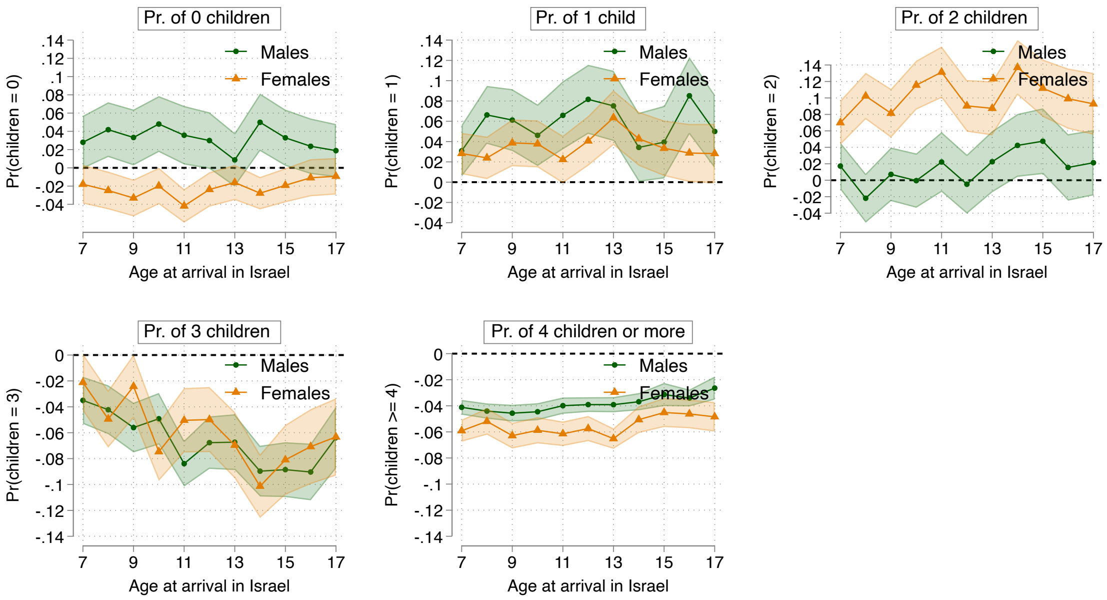
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the age at first child (left panel) and total number of children by age 35 (right panel). Estimated among the sample of PET test-taking stayers. Average age at first child among natives is 29.9 for men and 28.1 for women. Results condition on having at least one child.

Figure C5: Number of children by ages 35 and 39: Immigrant-native gap by age at arrival, sample of PET test-takers



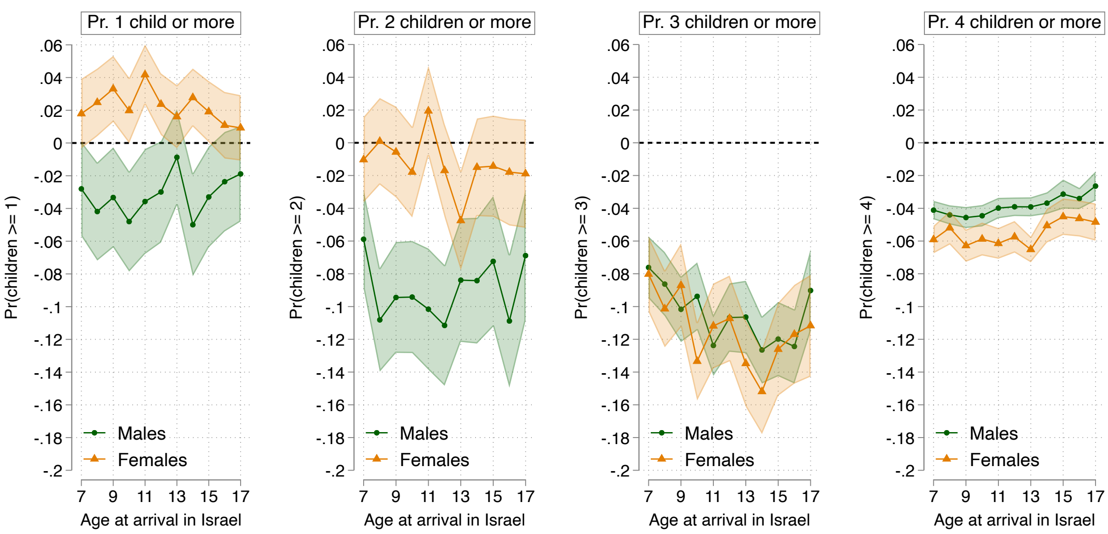
Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is the total number of children by age 35 or by age 39. Estimated among the sample of PET test-taking stayers. Average number of children by age 35 among natives is 1.56 for men and 2.02 for women. Average number of children by age 39 among natives is 2.03 for men and 2.40 for women. Results do not condition on having at least one child. The figure also reports the age-at-arrival coefficient estimates and standard errors of a version of equation (1) with linear age-at-arrival effects. * p<0.10, ** p<0.05, *** p<0.01.

Figure C6: Number of children distribution: Immigrant-native gap by age at arrival, sample of PET test-takers



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 35, where n is equal to 0, 1, 2, 3, or 4+. Estimated among the sample of PET test-taking stayers. The probabilities among male natives for having 0, 1, 2, 3, or 4+ children by age 35 are 0.27, 0.19, 0.33, 0.16, and 0.05, respectively. The probabilities among female natives for having 0, 1, 2, 3, or 4+ children by age 35 are 0.16, 0.14, 0.35, 0.26, and 0.09, respectively.

Figure C7: Total number of children CDF: Immigrant-native gap by age at arrival, sample of PET test-takers



Notes: Point estimates and 95% confidence intervals (robust standard errors) of parameters γ_k in equation (1) when outcome variable is a dummy equal to one if a person has n children by age 35, where n is equal to 1+, 2+, 3+, or 4+. Estimated among the sample of PET test-taking stayers. The probabilities among male natives for having 1+, 2+, 3+, or 4+ children by age 35 are 0.73, 0.54, 0.21, and 0.05, respectively. The probabilities among female natives for having 1+, 2+, 3+, or 4+ children by age 35 are 0.84, 0.70, 0.35, and 0.09, respectively.