Short- and Long-Term Consequences of Prenatal Conditions on Human Capital and Earnings*

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March 9, 2020

Abstract

This paper investigates the effects of in-utero exposure to better environmental conditions due to immigration from a developing country to a developed country during pregnancy on intermediate and long-term outcomes, using quasi-experimental variation created by the immigration of Ethiopian Jews to Israel in May 1991. Individuals in utero prior to immigration experienced a dramatic improvement in medical technologies, prenatal conditions, and prenatal care upon the move from Ethiopia to Israel. These changes affected individuals at different stages of prenatal development depending on their gestational age at migration. We find that females exposed to better environmental conditions at an earlier gestational age have lower grade repetition and dropout rates in high school, show higher high school achievement and higher matriculation rates, and earn more credit units in advanced courses. At young adulthood, they have higher post-secondary schooling, employment rates and earnings compared to those whose mothers migrated at a later stage of pregnancy. Early exposure to better environmental conditions also led to better behavioral outcomes in middle school for both boys and girls. We do not find an effect on birth weight, but we find a reduction in mortality for males.

*An earlier version of this paper was published as National Bureau of Economic Research (NBER) working paper no. 21894 in 2016. We delayed the current, revised version of the paper in order to allow individuals in our sample to reach the age of university schooling and enter the labor market, thus providing data on long-term outcomes. We thank the Israel Ministry of Education for allowing restricted access to secondary-school data in the Ministry's online protected research lab, and the Israel Central Bureau of Statistics (CBS) and National Insurance Institute (NII) for allowing restricted access to data on post-secondary school economic and social outcomes in their respective protected research labs. We benefited from comments and suggestions from Ran Abramitzky, Gabriella Conti, Pascaline Dupas, Marcel Fafchamps, Grant Miller, Petra Persson, Marcos Vera Hernandez, and seminar participants at the Hebrew University of Jerusalem, the IDC Herzelia, Stanford University, the University of Warwick, the University of York, the Barcelona GSE Summer Forum 2014, the Indian Statistical Institute's 10th Annual Conference on Economic Growth and Development (2014), the World Bank's 8th International Conference on Migration and Development (2015), the 4th SOLE/EALE World Conference in Montreal (2015), the Copenhagen Education Network Workshop 2015, and the NBER's 2015 Summer Institute conference in health economics. Lavy acknowledges financial support from the European Research Council (ERC) through ERC Advanced Grant no. 323439, and from the Maurice Falk Institute for Economic Research in Israel at the Hebrew University. Schlosser acknowledges financial support from the Pinhas Sapir Center for Development and the Foerder Institute for Economic Research, both at Tel Aviv University. Shany acknowledges financial support from the Henry Crown Institute of Business Research at Tel Aviv University.

1 Introduction

A large and growing literature shows that the intrauterine environment has longstanding effects on individuals, influencing health, cognitive and non-cognitive skills, and labor market outcomes later in life. The by now well-established fetal origins hypothesis (FOH; Barker, 1990) has meaningful implications for individual and policy decisions. Studies have shown that not only extreme but also relatively mild shocks in utero and in early life have short-term effects on children's health and long-term persistent effects on human capital development (see reviews by Almond and Currie, 2011; Currie and Vogl, 2013; and Almond et al., 2018).

Given the large waves of migration from developing to industrialized countries observed in recent decades, the strong evidence that in-utero conditions influence human capital development later in life has particularly important implications for developed countries hosting immigrants.[1] Yet no study has examined how conditions in utero affect outcomes for immigrants. This paper brings the "in-utero" literature into the context of migration to provide a better understanding of the intergenerational effects of migration.

We examine the effects of exposure to improved prenatal conditions due to immigration on a series of early childhood and longer-term outcomes, and explore the differential effect by pregnancy trimester at the time of exposure. We exploit quasi-experimental variation in exposure to better environmental conditions in utero generated by the large and sudden wave of Ethiopian Jews immigrating to Israel in 1991 through "Operation Solomon." This "out of Africa" immigration episode was unexpected and swift, with more than 14,000 Ethiopian Jews airlifted to Israel over a period of 36 hours on May 24 and 25, 1991. The operation, organized by the Israeli government, relocated almost all the Jews then living in Ethiopia to Israel. Thus, the immigrants were not a selected group, and the sudden occurrence and timing of the operation did not allow families to plan or time pregnancies or immigration dates. In this setting, variation in the timing of pregnancy relative to date of immigration can be regarded as random. These conditions provide a unique opportunity to evaluate the short-, intermediate- and long-term impacts of a shift from adverse prenatal conditions to improved conditions through immigration from an underdeveloped country to a developed one.

This paper is the first to present such a comprehensive analysis of prenatal conditions and their implications in terms of both diversity of outcomes and length of follow-up period.[2] In addition,

[1] Studies on the economic integration of second-generation immigrants show that children of low-skilled immigrants and refugees have, on average, worse educational and labor market outcomes than natives and children of high-skilled immigrants (see review by Sweetman and van Ours, 2015). Other studies have shown that both children's age at immigration and years spent by parents in the host country play a central role in children's educational and labor market outcomes (Böhlmark, 2008; Corak, 2012; Nielsen and Rangvid, 2012; Van den Berg et al., 2014)

[2] Other recent studies have examined the effect of prenatal conditions on later life outcomes while focusing on a specific domain (e.g., test scores, health, birth weight) at a specific age. For instance, Almond et al. (2015) and Greve

our data allow us to hone in on the timing of exposure during pregnancy, and to highlight heterogeneous effects of prenatal inputs during the critical periods of gestation.[3] The epidemiological literature suggests that the first trimester of pregnancy is the most pivotal period for brain and cognitive development.[4] Our quasi-experimental research design allows us to present causal evidence that corroborates these findings, providing important insights for policies aimed at targeting inputs for pregnant women.

We examine outcomes from a wide range of administrative datasets linked to individual demographic characteristics of all Operation Solomon children born in Israel between May 27, 1991, and February 15, 1992, within a narrow time window after immigration (May 24-25, 1991). For each child, we define treatment status based on gestational age at the time of immigration (first, second, or third trimester), and examine how exposure to better environmental conditions and prenatal care at the different stages of pregnancy affect various outcomes during childhood and early adulthood. Our primary analysis focuses on high school outcomes, including grade repetition, dropout rates, matriculation, and total number of matriculation credit units attained in all subjects, and in mathematics and English in particular. We also examine intermediate effects on test scores and behavioral outcomes in elementary and middle school, as well as long-term effects on post-secondary enrollment, labor market outcomes, welfare recipiency, fertility, and marriage.[5] We complement this analysis with estimates of effects on early life health outcomes, namely birth weight and child mortality.

We find that females exposed to better environmental conditions in utero during the first trimester of pregnancy performed substantially better in all medium- and long-term cognitive outcomes rel-

et al. (2017) find large negative effects of mild nutritional deprivation during pregnancy on test scores. Field et al. (2009), Feyrer et al. (2017) and Adhvaryu et al. (2019) show that relatively mild iodine deficiency during pregnancy can have large and long-term negative effects on children's cognitive ability. Others have found positive effects of family resources and access to medical care on postnatal outcomes (Rossin-Slater, 2013; Hoynes et al., 2016; Almond et al., 2018; Miller and Wherry, 2019).

[3]Almond and Mazumder (2011) and Almond et al. (2015) find that mothers' nutrition in the first trimester has the strongest impact on birth weight and cognitive outcomes at age 7. Carlson (2015) and Quintana-Domeque and Ródenas-Serrano (2017) find that stressful events during the first trimester lead to lower birth weight and premature birth, while Aizer et al. (2016) show that maternal stress during the third trimester has an adverse effect on test scores. Schwandt (2018) finds that exposure to influenza during the second or third trimester has a negative effect on labor market outcomes. Bharadwaj et al. (2017) find a strong negative effect on test scores among fourth-graders who were exposed to pollution during the third trimester in utero. Other studies suggest that the second trimester is most critical for early life health (see, e.g., Gunnsteinsson et al., 2019; Wernerfelt et al., 2017).

[4]Mihaila et al. (2011) and De Escobar et al. (2007) show that maternal dietary deficiencies of iron and iodine, respectively, during the first half of pregnancy are associated with a variety of poor fetal outcomes, including impacts on brain development and functioning in infancy and often throughout life. Nowakowski and Hayes (2008) and Loganovskaja and Loganovsky (1999) report that subclinical damage to human fetuses caused by radiation between 8 and 25 weeks of gestation, the most critical period for the generation of cortical neurons and their migration to the developing neocortex, can result in cognitive deficits that still manifest 16–18 years after birth.

[5]These outcomes are based on data from a different source, which is more limited than our main administrative dataset. Hence, the analyses for these outcomes are presented as additional results.

ative to those exposed to these better conditions at a later stage of pregnancy. Females who were in utero in Israel starting from the first trimester were about 15 percentage points more likely to obtain a matriculation diploma. This is a large effect, since the average matriculation rate of females who arrived in the third trimester is only 31%. Females who arrived in Israel during the first trimester also engaged in more challenging study programs during high school: they obtained almost 5 more credit units relative to those who arrived in the third trimester (an effect of about 50%), including 0.6 more credit units in mathematics and 0.8 additional units in English, implying gains of 30% and 50%, respectively. They were also 16 percentage points less likely to repeat a grade, and 7 percentage points less likely to drop out of high school. These effects persist into early adulthood (the latest time horizon we can observe now). Females who arrived during the first trimester were about one and a half times more likely to enroll in higher education than females who arrived during the third trimester. These educational gains are reflected in labor market outcomes: females who were in utero in Israel from the first trimester are 10% more likely to be employed compared with those arriving during the third trimester, and their earnings at age 23–25 are higher. We also obtain positive effects on behavioral outcomes and academic achievement during elementary and middle school, but we find no effect on birth weight or child mortality.

The results for males are less pronounced. Males who immigrated during the first trimester of gestation have lower mortality and better behavioral outcomes in elementary and middle school. However, these effects do not manifest in better school achievement or labor market outcomes even if we account for the selection of marginal males due to the decrease in mortality.

We assess the robustness of these results by controlling for birth cohort and seasonality effects. In particular, we extend our basic model by adding two comparison groups: individuals of the same birth cohorts born in Israel whose parents emigrated from Ethiopia prior to Operation Solomon; and individuals born in Ethiopia whose parents arrived in Israel after Operation Solomon. To further control for seasonality and cohort effects, we also examine outcomes for children of Ethiopian origin who were born a year earlier than our main sample; and we conduct a placebo test using a sample of children who immigrated in utero from the former Soviet Union. The results from these extended models and samples show clearly that the positive effect of the better environmental conditions in utero exists only for females who were in utero in Israel during the critical period (the first trimester), and cannot be explained by birth cohort or seasonality effects. Our results hold against a rich set of additional robustness checks that address other possible confounders, including stress, miscarriage, and premature births.

The main contribution of this paper is its finding that better environmental conditions due to immigration in the early months of pregnancy have beneficial effects on a wide range of outcomes at different points between early life and adulthood. This is the first study to provide causal evidence on this important question. The focus on children of immigrants is particularly important for Western countries that have become destinations for migrants and refugees from poorer nations. Our findings that better environmental conditions and prenatal care during pregnancy improve short-term, intermediate and long-term outcomes provide a rationale for targeting resources toward young children of immigrant families who were born abroad and, especially, toward pregnant immigrant women. It also has paramount implication for poor nations, since it identifies a pre-birth period where improved conditions can have economically meaningful payoffs in the long run.

The remainder of the paper is organized as follows. The next section outlines the historical background of Ethiopian Jews and the differences between the environmental conditions they experienced in Ethiopia and upon arrival in Israel. Section 3 describes our data, and section 4 outlines our empirical strategy. In Section 5 we report our results showing the effect of environmental conditions in utero on a variety of outcomes. Robustness checks are presented in Section 6. In Section 7 we examine potential alternative interpretations and discuss measurement issues. Section 8 concludes.

2 Context

2.1 Immigration of Ethiopian Jews to Israel[6]

The Ethiopian Jewish community, also known as "Beta Israel," lived in the region of Northern Ethiopia called Gondar for at least several centuries.[7] The existence of this remote community became known in the Jewish world only late in the nineteenth century, and they were recognized as Jewish by the State of Israel in 1975, after a ruling by Israel's Chief Rabbinate that recognized the Beta Israel as descendants of one of Israel's lost tribes. They were then entitled to migrate to Israel as full citizens under the Law of Return. Since then, 92,000 Ethiopians have been brought to Israel in organized immigration projects and immediately become Israeli citizens.

Figure 1 presents the distribution of Ethiopian Jewish immigrants to Israel by immigration year. The peak in 1984 reflects worsening conditions in Ethiopia due to a major drought and consequent famine, and the unstable political situation during this period. Thousands of Beta Israel fled Ethiopia on foot for refugee camps in Sudan, a journey which took from two weeks to a month. It is estimated that as many as 4,000 died during the trek, due to violence and illness along the way. Sudan secretly allowed Israel to evacuate the refugees in a project known as "Operation Moses," which began on November 21, 1984. This operation involved the air transport of about

[6]This section is based on Kaplan (1992)

[7]While the origins of the Ethiopian Jewish community are debated, one theory holds that after the rise of Christianity in Ethiopia in the fourth century, Jews who refused to convert were persecuted and withdrew to the mountainous Gondar region.

8,000 Ethiopian Jews from Sudan via Brussels to Israel. It ended on January 5, 1985, when the operation became public and Arab countries pressured Sudan to stop the airlift.

Between 1985 and 1989 the Ethiopian authorities limited the movement of all citizens, Jews included, making emigration almost impossible. The renewal of diplomatic relations between Israel and Ethiopia in November of 1989, and the involvement of American and Canadian Jewish organizations, in particular the American Association for Ethiopian Jews (AAEJ) and North American Conference on Ethiopian Jewry (NACEJ), opened new possibilities to renew immigration to Israel. In May 1990, the AAEJ hired buses to bring Jews from their villages in the north of the country to the capital Addis Ababa, where the NACEJ operated a compound in which Jewish families could reside until they received permission to fly to Israel. They did not know when that permission would be granted, and they accepted the fact that they would be living in Addis Ababa for the time being. However, following political and military turmoil in Ethiopia, culminating in the Ethiopian dictator Mengistu's flight from the country in May 1991, the Israeli government decided to airlift the Ethiopian Jews from the capital before rebel forces took it over. On May 24 and 25, 1991, over 14,000 Ethiopian Jews—all the Jewish population then living in Addis Ababa, and almost the entire Jewish population remaining in Ethiopia—were airlifted to Israel within 36 hours in Operation Solomon (see Figure 2) . Upon arrival in Israel, the immigrants were placed in absorption centers, where most stayed for several years until they were able to move to permanent housing.[8] Immigration from Ethiopia to Israel continued after Operation Solomon, but in smaller numbers. Through 1999 the immigrants mainly comprised Jews from rural areas in Qwara near Gondar. Since then, they have largely been members of the Falash Mura people.[9]

2.2 Environmental Conditions of Operation Solomon Immigrants in Ethiopia and in Israel

Pregnant mothers were exposed to large environmental differences between Ethiopia and Israel. We conducted in-depth interviews with fifteen mothers of children from our base sample who were pregnant at the time of immigration, and asked them about conditions in five areas before and after immigration: living conditions; general medical care; overall nutrition; micronutrient supplements; and antenatal care and monitoring. Section A in the Online Appendix outlines the differences between Ethiopia and Israel based on these interviews, media reports from the period, and other relevant literature. The main features of these findings are summarized briefly here.

[8]For more details, see Gould et al. (2004).

[9]Falash Mura is the name given to members of the Beta Israel community in Ethiopia who converted to Christianity under pressure from missionaries during the 19th and 20th centuries. In 2003, the Israeli government gave those with Jewish maternal lineage (through the Beta Israel) the right to immigrate to Israel under the Law of Return, but to obtain citizenship only if they converted to Orthodox Judaism.

Living conditions. Prior to Operation Solomon, Ethiopian Jews lived in a traditional society in small remote rural villages in northern Ethiopia, with almost no access to schools. After their arrival in Israel, most (80%) were housed initially in absorption centers comprising furnished rooms or apartments, and the rest in mobile home camps (Gould et al., 2004).

General medical care. In Ethiopia, traditional practitioners provided homemade medications and treatments. The first exposure of Ethiopian Jews to Western medical practices was in Addis Ababa before their evacuation to Israel. This included immunization and treatment by Israeli doctors, which reduced significantly the death rate in the community in the following months (Myers, 1993). Upon arrival in Israel, the immigrants underwent extensive medical examinations (Nahmias et al., 1993). In most of the absorption centers they had access to a primary care clinic, staffed by a physician, a nurse, and an interpreter/mediator (Flatau et al., 1993; Sgan-Cohen et al., 1993; Shtarkshall et al., 2009; Levin-Zamir et al., 1993), which provided comprehensive health and immunization services (Yaphe et al., 2001 and Levin-Zamir et al., 1993).

Nutrition. Upon arrival in Israel, the immigrants' calorie intake almost doubled. In addition, its composition changed, as many traditional Ethiopian staples were not available in Israel at the time (Levin-Zamir et al., 1993).

Micronutrient supplements for pregnant women. Three micronutrient supplements which are important for cognition and are recommended for pregnant women—iron, iodine and folic acid—were mostly unavailable in Ethiopia (DHS, 2000).[10] In Israel, it was standard practice at the time to prescribe pregnant women vitamins containing iron and folic acid, and the food chain contains adequate amounts of iodine (Benbassat et al., 2004).[11]

Antenatal care and monitoring. In Ethiopia, more than 75% of pregnant mothers received no antenatal care, and the majority of births (over 95%) took place at home without the assistance of trained professional (DHS, 2000). In Israel, women had access to pre- and postnatal monitoring of the mother and baby, and almost all births were at hospitals. Infant mortality was 12% in Ethiopia and 1% in Israel.

[10] Online Appendix B provides additional information on the importance of micronutrients for development.

[11] Israel is one of the few Western countries that have no iodization policy, largely because of the perception that Israel is an iodine-sufficient country due to its proximity to the Mediterranean (Zohar, 1994). Indeed, a national iodine survey was not performed in Israel until 2013. According to Ovadia et al. (2013), there is some recent evidence for inadequate iodine intake in Israel (two-thirds of the recommended dietary allowance), possibly due to the increasing proportion of desalinated seawater in Israelis' drinking water (desalination plants typically remove 90–98% of soluble minerals, including iodine, from seawater). However, desalination of seawater began in Israel a few years after the period in our analysis, meaning that our sample can be assumed to have had adequate iodine intake once in Israel.

3 Data

3.1 Main Study Sample

The baseline population from which we derive our main sample is the Ethiopian population in Israel born in Ethiopia or in Israel during the years 1980 to 2005. These data are derived from Israel's Population Registry, which we accessed through the Israel Central Bureau of Statistics research room. For all individuals in our sample, our data include birth date; date of immigration; country of origin; parents' date of immigration and country of origin; number of siblings; and mother's place of residence upon arrival in Israel. We merge these data with administrative records on birth weight for individuals born in Israel collected from hospital delivery records, and with data on parents' income from the Israel Tax Authority. We then identify those individuals for whom both parents immigrated to Israel from Ethiopia in Operation Solomon on May 24 or 25, 1991, and link these data to administrative records collected by the Israel Ministry of Education, specifically information on students' parental education, yearly schooling status (graduated, currently attending school, dropped out), and high school matriculation exam outcomes.[12]

We focus on two sets of high school outcomes capturing different degrees of performance. The first measures schooling attainment by the following indicators: repeating a grade after primary school (after sixth grade), completing high school, and receiving a matriculation certificate.[13] The second set of outcomes measures quality of schooling attainment, and includes the following variables: total credit units awarded in the matriculation certificate, and credit units awarded in mathematics and English, which are highly correlated with IQ (Dvir et al., 2009).[14] We do not use test scores as outcomes because a large proportion of our sample did not take matriculation exams, or took only some of the exams offered.[15]

Our primary sample comprises 570 individuals born in Israel whose pregnancy was incepted in Ethiopia, and whose parents immigrated to Israel during Operation Solomon. That is, we select all individuals born to Operation Solomon immigrants between May 27, 1991, and February 15,

[12]We used the precise date—i.e., May 24 or May 25—in our calculations of gestational age at immigration.

[13]Since our sample comprises individuals born between 1991 and 1992, most should have completed or left high school by 2011, when they would have been about 19 years old. Until 2007, Israeli law mandated compulsory education through the 10th grade; in 2007 the law was amended to extend compulsory education through grade 12. A matriculation certificate is a prerequisite for admission to academic post-secondary institutions, and is also required by many employers. To receive a matriculation certificate, students must pass a series of national exams in core and elective subjects during the high school years.

[14]Students taking matriculation exams can choose to be tested at different levels of proficiency in each subject, with each test awarding the student between one and five credit units (one is the lowest level and five the highest).

[15]Given that all matriculation and school attainment outcomes that we examine are binary or count variables, they are also well-defined for those in the sample where values are missing because the individual died or dropped out of school. We therefore analyze the full sample of data for all outcomes, thus avoiding selection issues. We discuss this in detail in section 5.3.c, where we analyze mortality and assess the robustness of our main results.

1992, excluding seven pairs of twins.[16] This yields cohorts that experienced different spans of time under Israeli living standards between conception and birth.

Table 1 presents summary statistics showing the background characteristics for our primary sample, and for our two comparison samples: individuals of Ethiopian origin born during the same period (May 27, 1991–February 15, 1992) whose families immigrated to Israel before (group A) or after (group B) Operation Solomon. Columns 1–3 present means and standard deviations for all the individuals in our primary sample, and separately by gender. Columns 4–6 present the same data for individuals born in Israel to Ethiopian parents who immigrated before 1989, most in Operation Moses (group A), and columns 7–9 for individuals born in Ethiopia who immigrated to Israel after 1991 but before 2000 (group B). As we will discuss later, these two additional groups allow us to control for birth cohort and seasonality effects in the empirical analysis.

Mothers of the individuals in our main sample (columns 1–3) were on average around 30 years of age upon giving birth, while fathers were about 40. Families are relatively large, with 5.3 children on average; individuals in our sample were, on average, the third or fourth child in the family. Their parents tended to have little formal education (1–2 years of schooling). Looking at the comparison samples, individuals with Ethiopian parents who arrived in the previous immigration wave (columns 4–6) came from slightly smaller families (4.4 children on average), and their parents had more years of schooling (about 4 on average). Those whose parents immigrated after 1991 (columns 7–9) have similar background characteristics to those who arrived in Operation Solomon. One important difference between the groups is parental income in 1995. As expected, parental income is much higher for the group A sample (the previous immigration wave) and lower in the group B sample (the later immigration wave) relative to our primary sample. Overall, no large differences in family background characteristics were found between boys and girls.

Panel I of Table 2 reports means and standard deviations of the high school outcome variables for our main sample and the two comparison cohorts. High school academic achievement in our primary sample (column 1) is lower than that of individuals born in Israel to Ethiopian parents who arrived before 1989 (column 4), but similar to that of individuals who were born in Ethiopia and arrived in Israel after 1991 (column 7). For example, the matriculation rate at age 18 is 30% for our primary sample, 36% for the Ethiopian-origin Israeli-born sample (group A), and 30% for the Ethiopian-born sample (group B). The rate for all Israeli twelfth-grade students was 59% in 2012.[17] The means of other educational outcomes follow the same pattern: individuals conceived in Ethiopia (columns 1 and 7) have lower educational achievement than individuals of Ethiopian origin who were conceived in Israel. In all samples, females have higher high school academic

[16]The calculation assumes 38 weeks of post-conception gestation. Twins were excluded because they tend to have different birth outcomes from singletons.

[17]Source: Israel CBS, Statistical Abstract of Israel 2014, p. 406.

achievement compared to males.

Panel II of Table 2 reports the means and standard deviations for early life health outcomes (birth weight and child mortality). As these data are available only for individuals born in Israel, we can compare the Operation Solomon offspring only with those born in the same period whose parents came to Israel in the previous immigration wave. Birth weight in our primary sample is about 3 kg, not significantly different from that for offspring of the previous wave. About 9% of the females and 6% of the males in our primary sample were born at low birth weight (less than 2.5 kg). The mortality rate by age 6 in our primary sample is 1.4% and is slightly higher for males than females (1.7% versus 1.1%). The equivalent rate for the Israeli population during the same period was about 1% (World Bank data catalog, 1991).

3.2 Sample for Additional Analysis

In our analysis we also examine additional outcomes at middle childhood and early adulthood, compiled from various datasets at Israel's National Insurance Institute (NII) research data center. For these outcomes, the sample comprises 557 individuals from our primary sample of 570 who were in utero during Operation Solomon. The dataset includes test scores in four subjects (math, Hebrew, science and English) and behavioral outcomes measured by national standardized tests and student questionnaires administered during elementary and middle school. In addition, it includes several outcomes measured when the individuals in the sample were aged 26, including enrollment at any post-secondary institution, employment, earnings, welfare payments, childbearing, and marital status, which were compiled from various administrative datasets. See Online Appendix C for more details about these data.

To address the issue of multiple hypothesis testing directly and to draw general conclusions about treatment effects on middle school test scores and behavioral outcomes, we first converted test scores into z-scores by subject and year and stacked data for the four subjects. We then grouped seven items in the student questionnaires that relate to students' feelings or self-reported behavior into one category by computing z-scores for each item and averaging within each student. These seven items were as follows: (1) I have a good understanding of my teacher's scholastic requirements; (2) I know what behavior is allowed or forbidden in school; (3) This year I was involved in many fights [reversed]; (4) Sometimes I'm scared to go to school because there are violent students [reversed]; (5) I feel well-adjusted socially in my class; (6) When I have a problem at school there is always someone I can turn to from the teaching staff; and (7) I feel good in school. Students were asked to rate the extent to which they agreed with each statement on a 6-point scale where 1 = "strongly disagree" and 6 = "strongly agree."

Table 3 reports means and standard deviations of the outcomes based on the NII sample. Girls have higher test scores and better behavioral outcomes than boys. With respect to the outcomes in adulthood, overall, 25% of the individuals in the sample had enrolled in any sort of post-secondary education, and 19% had done so at higher-tier institutions (universities or colleges). For comparison, the equivalent enrollment rates for the same cohort in the total Jewish population of Israel were 44% and 31.5%, respectively.[18] Enrollment rates are substantially higher for females, by 20 percentage points. About 12% of the sample received welfare benefits (either disability payments or income support) between the ages of 18 and 26. This rate is similar for females and males. The employment rate at age 23–25 is 90%, with higher rates for females (92% vs. 88%). Because young adults in Israel typically do compulsory military service from the age of 18, with the normal length of service two years for females and about three years for males, it is not unusual for Israelis aged 23 through 25 to still be enrolled in post-secondary schooling. However, in our sample, we do not find a significant difference between the rates of those who were registered as employed at age 23–25, and those who were registered as either employed or studying. Hence, it appears that most of the individuals in our sample were not enrolled in a course of study at age 23–25. Monthly earnings are on average NIS 4,225 (equivalent to about US $1,500). Despite their higher employment rate, the monthly earnings of females are lower than those of males (NIS 3,816 compared to NIS 4,612). The gap widens once we condition monthly earnings on employment. Marriage rates by age 26 are relatively low (15% for females and 4% for males). Fourteen percent of the women and 5% of the men also had children by that age.

4 Empirical Strategy

4.1 Baseline Model and Specification

The nature and timing of Operation Solomon creates a quasi-experimental framework, where children of Ethiopian immigrants who shared the same background characteristics and were born shortly after arrival in Israel experienced one important differential treatment: their mothers were at different stages of pregnancy on the day of immigration. That is, all these children faced the same general conditions at birth and in later life, but potentially experienced dramatic differences in prenatal conditions based on their gestational age upon arrival in Israel in May 1991. Children who were conceived earlier, and who were therefore in utero in Ethiopia for a longer period, faced micronutrient deficiencies, inadequate health care, and a lower standard of living over more months of gestation. By contrast, children who were conceived not long before Operation Solomon were in utero in Israel for a longer period, and could benefit from the better environmental conditions characteristic of a developed country.

[18]For figures on the Israeli population, see the CBS: `https://old.cbs.gov.il/shnaton69/st08_54.pdf`.

We therefore estimate the causal effect of these improved conditions in utero on later life outcomes by comparing outcomes of children who arrived in utero at different stages of pregnancy. Our main identifying assumption is that children who were born in Israel but whose mothers were at different stages of pregnancy at the time of immigration have identical unobserved characteristics and the same mean potential outcomes. In other words, we assume that the timing of conception in Ethiopia relative to the timing of immigration was random.

Migration decisions, including the timing of migration, are usually endogenous, and correlate with characteristics of the immigrant. Operation Solomon created a different setting, as it was an unexpected event completed in a very short time. The airlift was organized by the Israeli government, and it brought to Israel almost the entire Jewish community still in Ethiopia at the time. Thus, the immigrants were not a selected group. Moreover, the timing of the operation was unknown in advance. Hence, pregnancies could not be planned around the expected migration date, and immigration could not be planned around the expected due date.[19] This sudden immigration event generated a unique exogenous improvement to in-utero environmental conditions, thus allowing us to identify the causal effect of these conditions on later life outcomes among children who encountered them at different gestational ages but experienced the same conditions at birth and later life.[20]

We do not include in our analysis children who were born just before the airlift, since these children faced very different conditions during birth compared to children who were born in Israel. In addition, there is positive selection in terms of survival among children who were born just before the airlift. On average, six children were born per week to the Ethiopian migrants in the three months before the airlift, and 15 children per week during the nine months after the airlift (we did not observe any difference in the sex ratio between these two groups). We also do not include in our analysis children who were born beyond nine months after the airlift, as those children were conceived in Israel. For these children, we cannot claim that the timing of conception relative to the timing of immigration was random.

The key variable for our analysis is gestational age of the child at immigration. Gestational age is measured as the difference between the date of immigration (May 24 or 25, 1991) and the individual's birth date, transformed into numbers of weeks and then subtracted from 40 (the standard measure of gestation). We assume 38 weeks of post-conception gestation, which is equivalent to 40 weeks of gestational age. We are interested only in the 38-week period after fertilization, rather than the traditional 40-week measure, because we do not want to include children whose mothers

[19]It is reasonable to assume that there was no family planning within the Ethiopian Jewish population before immigration. The contraceptive prevalence rate in Ethiopia in 1990 was only 2.9% (Olson and Piller, 2013), while the total fertility rate among Ethiopian immigrants was 5.2 (Israel CBS, 2003).

[20]A similar approach is used by studies that examine the effect of policies which change household resources, such as Hoynes et al. (2016).

became pregnant upon arrival in Israel. We therefore drop those who immigrated at weeks 0 and 1 from our analyses. [21]

In the medical literature, it is common to divide the duration of pregnancy into three trimesters. We therefore define treatment categories by gestational age at the time of immigration as follows: (1) first trimester—conception (week 2) through week 12; (2) second trimester—week 13 through week 26; and (3) third trimester—week 27 through birth. These three trimesters can be mapped into three groups defined by date of birth, where children born between December 4, 1991, and February 15, 1992, are assumed to have arrived in Israel during the first trimester; children born between August 28 and December 3, 1991, are assumed to have arrived during the second trimester; and children born between May 27 and August 27, 1991, are assumed to have arrived during the third trimester (these dates assume an immigration date of May 24, 1991). Figure 3 graphically depicts the three trimesters by birth date and estimated conception date. One potential challenge regarding our definition of the treatment is that we do not have precise information on conception dates, but estimate these using date of birth. This means that we might misclassify some children in terms of their length of exposure in utero to the Israeli environment. We discuss this issue in Section 7 and show that our results are robust to potential misclassifications of treatment status.

The medical literature (e.g. Cunningham et al., 2014) suggests that the first trimester is a period of rapid growth for both internal and external body systems and organs. By the end of the first trimester, even though the fetus is less than two inches long, all the major systems and organs are developed, including the brain. In the second trimester, the fetus grows considerably in size. By the beginning of the third trimester, the fetus may survive if born premature. In this period, growth slows down but there is substantial weight gain.

We examine the effect of length of exposure to the Israeli environment by estimating the following model:

$$Y_i = \beta_0 + \beta_1 FirstTrimester_i + \beta_2 SecondTrimester_i + \gamma X_i' + u_i \tag{1}$$

where Y_i is the outcome of individual i. The dummy variables $FirstTrimester_i$ and $SecondTrimester_i$ are the key explanatory variables that denote arrival during the first or second trimester of pregnancy respectively. The omitted category includes those who arrived in Israel during the third trimester (individuals with the shortest exposure to better in-utero conditions, whose mothers spent most of their pregnancy in Ethiopia). The estimated parameters β_1 and β_2 reflect the difference

[21] Gestational age is defined based on the number of weeks elapsed from the mother's last menstrual period. The average length of a pregnancy as computed by gestational age is 40 weeks, which means 38 weeks from the point of fertilization. We employ the traditional measure of gestational age in order to maintain consistency with the common nomenclature, while dropping weeks 0 and 1 in order to ensure that all individuals in the sample were conceived before immigration.

between exposure to better environmental conditions starting from the first or second trimester, respectively, relative to the third trimester. X_i' is a vector of individual characteristics; it includes a gender dummy, mother's age at birth, parents' age gap, birth order, parents' education, and the socio-economic index of the mother's first locality of residence upon immigration to Israel.[22]

If exposure to better environmental conditions in utero enhances cognitive abilities, we expect $\beta_1 > \beta_2 > 0$. The quasi-experimental variation generated by the inability to anticipate the date of immigration relative to conception date guarantees that duration of exposure to better conditions in utero is uncorrelated with the residual. Hence, the parameters β_1 and β_2 can be interpreted as causal.

We estimate equation (1) for females and males separately as a system of seemingly unrelated regressions, on the assumption that we can expect differential effects of the treatment by gender. Previous studies on in-utero and early childhood shocks have found significant differences by gender. For example, Field et al. (2009) investigate the effect of an in-utero micronutrient supplement (iodine) in Kenya and find greater improvements for girls than for boys.[23] Adhvaryu et al. (2019) also find a larger effect on the labor supply of women compared with men when examining the impact of iodine fortification in the U.S.[24] Hoynes et al. (2016) find that increasing family resources during early childhood improves health at adulthood for both men and women, but has a positive significant effect on economic self-sufficiency only for women. Gould et al. (2011) also find that improvements in early childhood living conditions in families that emigrated from Yemen to Israel in 1948–49 affected only girls. Positive effects on girls were found for short-term outcomes such as schooling, and also long-term outcomes such as employment and earnings at age 55–60. Brown et al. (2019) examine long-term impacts of childhood Medicaid eligibility expansion on outcomes in adulthood, and show stronger and larger effects on fertility and wages for females.

[22]The Israel CBS computes a socio-economic index of Israeli localities based on several demographic and economic variables, including dependency ratio, average years of schooling in the adult population, percentage of academic degree holders, employment and income levels, etc. Lower values correspond to lower socio-economic status.

[23]Recent evidence highlights biological gender differences in iodine sensitivity in utero. Results from laboratory studies in animals show greater sensitivity of the female fetus to maternal thyroid deprivation, with negative consequences for cognitive development. Friedhoff et al. (2000) found that artificially restricting maternal thyroid hormone in utero had a significantly greater effect on fetal neurodevelopment and behavioral outcomes in female relative to male rat progeny. Although the mechanism underlying heterogeneity in the effects by gender could not be directly addressed by their experiment, a recent study of gene expression in nutrient-deprived fetal guinea pigs by Chan et al. (2005) provides insight into the cellular pathways.

[24]The medical literature also finds differential effects of iron deficiency in utero by gender based on animal models. Kwik-Uribe et al. (2000) showed that in male mice, the detrimental effects of iron deficiency in utero could be totally reversed through eight weeks of postnatal iron supplementation, while no such effect was found for females. One explanation offered by the authors is that the ovarian hormones modulate dopamine metabolism and function, contributing to gender-specific biochemical responses. More detailed discussions in the medical literature of the physiological mechanisms that lead to differential effects of micronutrient deficiency by gender are beyond the scope of this paper.

4.2 Controlling for Cohort and Birth Month Effects

A potential concern about the baseline specification presented above is that the estimates may be confounded by unobserved cohort or seasonality (birth month) effects on school performance, since the students in the full treatment group (first trimester) are younger. To address these concerns, we examine two comparison groups who were born within the time window of interest, and who experienced either the full treatment (comparison group A) or no treatment (group B). This allows for estimation of birth cohort and seasonality effects via a sort of difference-in-differences (DID) framework. As discussed in section 3.1, comparison group A comprises second-generation immigrants whose families arrived via Operation Moses (i.e., before 1989) and who were born in the same time window as our primary sample. Because all the children in group A were conceived in Israel, all fall into the full-treatment category, and differences between individuals born in different months should reflect cohort effects and birth month (seasonality) effects in Israel. However, since the conception of our main sample was in Ethiopia, seasonality effects on the timing of conception will not be captured by comparison group A. We therefore add comparison group B—individuals born in Ethiopia during the period of interest who immigrated after Operation Solomon, but before the year 2000.[25] Because all the children in group B experienced their entire gestation in Ethiopia, they are all considered untreated, and so the difference between children born in different months in this group should only reflect cohort effects and seasonality in the timing of conception in Ethiopia. The key assumption in this analysis is that the birth cohort and birth month effects of these two groups are good proxies for the same effects in our main sample of in-utero Operation Solomon immigrants.

The Operation Solomon group and the two comparison groups differ in many respects. However, individuals in all three groups originate in the same country, have the same genetic profile and culture, and were raised by immigrant parents. Moreover, all were conceived around the same time. Thus, we expect that cohort and seasonality effects will be similar for these three groups.

Finally, to net out seasonality effects from effects that derive from the differences between our primary group and the two comparison groups, we also examined outcomes for children of parents who arrived in Israel during these three different immigration waves, but who were born a year earlier than our main sample. That is, we add three additional groups comprising individuals born between May 27, 1990, and February 15, 1991. Individuals in the first group immigrated to Israel with their families in May 1991. These individuals are untreated as they were born in Ethiopia. However, they belong to the same population as our treatment group of Operation Solomon immigrants, and so have the same family backgrounds. The second group comprises offspring of

[25]While immigration from Ethiopia to Israel continued after 2000, we restrict our comparison group to individuals who immigrated before that year in order to include only children who were in Israel in time to begin their secondary education there, and to exclude the Falash Mura people.

Ethiopian parents who immigrated before 1989 and were born in Israel, while the third group includes individuals born in Ethiopia who immigrated with their parents after 1991. The estimated model is then specified as follows:

$$\begin{aligned} Y_i = \beta_0 + \beta_1 FirstTrimester_i + \beta_2 SecondTrimester_i + \alpha_1 ETH_i + \alpha_2 PreCohort_i \\ + \alpha_3 ETH_i * PreCohort_i + \alpha_4 GroupA_i + \alpha_5 GroupB_i + \gamma X_i' + \delta MOB_i + u_i \end{aligned} \tag{2}$$

where $FirstTrimester_i$ and $SecondTrimester_i$ are as described for equation (1). X_i' is a vector of the characteristics of individual $i\prime$ (defined as in equation 1), and MOB_i is a vector of month of birth fixed effects.[26] ETH_i is an indicator for individuals born in Ethiopia. This includes individuals who immigrated during Operation Solomon (the older cohort matched to our primary sample) and individuals who immigrated after 1991. $PreCohort_i$ is an indicator for individuals born between May 27, 1990, and February 15, 1991 (the older cohort). $GroupA_i$ is an indicator for individuals born in Israel to Operation Moses immigrants (the first comparison group), and $GroupB_i$ is an indicator for individuals born in Ethiopia who immigrated after Operation Solomon (the second comparison group). The parameters β_1 and β_2 represent the treatment effect net of seasonality and cohort effects. Due to limitations of the data provided by the NII, which included only our main analysis sample, we estimate equation (2) only for the high school outcomes, birth weight and mortality.

5 Results

5.1 Balancing Tests on Observables and Birth Frequencies

Our main identifying assumption is that the timing of pregnancy relative to immigration date can be seen as random among mothers who were already pregnant when airlifted to Israel on May 24 or 25, 1991. We support this assumption by showing in this section the similarity in background characteristics among individuals from the three trimester groupings. In addition, we show that the frequency of births in the three trimester groupings is similar to the observed frequencies in the two comparison groups born during the same time period.

Table 4 presents means of background characteristics for individuals whose mothers arrived in Israel during the first trimester, and differences in these characteristics between trimesters. In addition, we report F statistics and p-values for joint significance of all covariates. The data are presented for the sample as a whole (columns 1–4) and by gender (columns 5–12).

[26]Some of the children in our sample who were born in Ethiopia (about 10%) have missing values for month of birth. We assign to these children a random month of birth and include a dummy for it in the specification.

The median gestational age at day of immigration is 7 weeks for the first-trimester group, 20 weeks for the second-trimester group, and 32 weeks for the third-trimester group. There is no difference in median gestational age by gender. The median is roughly in the middle of the range for each group, so no group is over-represented.

The proportion of females in the first- and third-trimester groups is similar (around 47% with a gap of 0.012), and slightly but not significantly lower in the second-trimester group (around 43%). Overall, there are no marked differences for either females or males in most background characteristics of individuals in the full sample who arrived in Israel at different stages of their mother's pregnancy. For females, differences in parental education by trimester of arrival are not statistically significant, except for a disadvantage in mothers' education for those who arrived in the first trimester relative to the second or third. There is also a significant disadvantage in SES index for locality of residence of mothers who arrived in the first trimester relative to the second. This leads to a low p-value for the test of jointly significant differences in covariates between the first and second trimester. However, this calculation militates against our main concern, which is the possibility of positive selection bias if better family background correlates with arrival in Israel at earlier stages of pregnancy. We also find that covariates cannot jointly predict birth in either the first- or second-trimester groups versus the third-trimester group for females.

For males, there are some differences in parental schooling between the trimester groups: father's education is higher among those who arrived in the first trimester relative to the third, and mother's education is higher among those who arrived in the second trimester relative to the third. Overall, there are some differences in the characteristics of boys between the trimester groups, although they are mainly evident in one covariate.

We assess this further by estimating a regression of weeks of gestation upon arrival in Israel on all covariates. The F statistic for joint significance of all covariates is 0.8, and the p-value is 0.616 (with similar numbers for females and males separately), meaning there is no clear trend showing an association between better family background and longer exposure in utero to the Israeli environment (i.e., arrival at earlier stages of pregnancy). Furthermore, we do not find significant differences in parental characteristics or family structure by the timing of birth for the comparison groups used to control for seasonality and birth cohort effects (results available upon request). These results support our claim that treatment exposure is indeed random in this natural experiment.

Figure 4 plots the frequency of births in our primary sample (Operation Solomon children) and in the two comparison groups by month of birth and by immigration trimester (by date) for the whole sample (Panel A) and for females and males separately (Panels B and C). The frequency of births for those immigrating in the three trimesters is similar across the three samples, and there is no clear evidence for selection of births at the trimester cutoffs. To further examine this issue, we plot in Figure 5 the share of births by gestational week upon immigration to Israel for the three groups. Gestational week for the comparison groups was computed as in the Operation Solomon sample. The vertical lines denote the trimesters. The figure shows two important points: (i) there is no clear discontinuity around the trimester cutoffs in our main analysis sample; and (ii) the share of births by week is not significantly different across the three groups. To formally test this issue, we also estimated a model where the dependent variable is the share of births by week, and examined whether there were significant differences by trimester groups between our main sample and each of the two comparison groups. The results (available upon request) show no significant differences in any of the three trimester groupings.

5.2 Main Results: High School Outcomes

Table 5 presents the results for high school outcomes by gender. Odd columns present estimates for β_1 and β_2 of equation (1), and even columns present estimates for β_1 and β_2 of equation (2), where we account for seasonality effects. Panel A reports estimates for females and Panel B for males. Panel C reports p-values from F-tests for the test of equality of parameters between females and males. We also report means and standard deviations of the outcome variables for the reference group, which is individuals whose mothers arrived during the third trimester.

Estimates of the effect of earlier exposure to better environmental conditions in utero on high school outcomes reveal an interesting differential pattern by gender. We observe a large impact of exposure in the first trimester for females in all outcomes. In contrast, the impact for males is smaller and not statistically significant. The DID estimates are very similar to the respective ordinary least squares (OLS) estimates, suggesting that seasonality does not play a role in the OLS results.

For females, exposure from the first trimester lowers the likelihood of repeating a grade by 17 percentage points (s.e.=0.044). For males, this effect is insignificant. Exposure from the second trimester also lowers grade repetition for females, but the effect is smaller, though the estimates for the first and second trimesters are not statistically different. Exposure to the Israeli environment from the first trimester for females raises the high school completion rate by 7.5 percentage points (s.e.=0.040). The average rate of high school completion among females in the third-trimester group is 89%; therefore this absolute gain implies an 8% increase. This effect is similar to findings of other studies that estimated the effect of prenatal conditions on cognitive outcomes. For example, Field et al. (2009), find that that intensive iodine supplementation for pregnant women in Tanzania increased schooling by half a year, a 6% increase. Almond (2006) found that prenatal exposure to an influenza pandemic reduced schooling by 0.25 years (2.3% relative to an average of 10.6 years of schooling), and the likelihood of completing high school by 0.03 percentage points

(6% relative to an average rate of 48%).

Performance in Israel's matriculation exams among females is also improved by longer exposure to treatment: exposure from the first trimester increases the matriculation rate by 18 percentage points (s.e.=0.082)—an improvement of about 60% relative to the mean of 31% for the third-trimester group. This gain amounts to 50% of the matriculation gap between non-Ethiopian Israeli Jewish females and Ethiopian immigrant females. This effect size is larger compared to the effect of attending a high- versus low-quality primary school among Ethiopian students in Israel (Gould et al., 2004). Indeed, it is even larger than being exposed at age 15-16 to a large increase in the rate of return to schooling (Abramitzky and Lavy, 2014). By comparison, Almond et al. (2015) and von Hinke Kessler Scholder et al. (2014) report 20% declines in test scores following prenatal exposure to negative malnutrition and alcohol shocks, respectively. However, those findings are for females and males together.

The above gains are accompanied by improvements in other measures relating to the quality of the high school matriculation study program, as shown in columns 7 through 12. Females who arrived in the first trimester earned almost 5 more matriculation credit units (s.e.=1.371) than females who arrived in the third trimester, a gain of almost 50%. Credit units in math and English rise by about 0.7 and 0.8 units, respectively, for gains of (respectively) about 60% and 40%. These are considerable, and important, quality gains. Estimates for arrival in the second trimester on the quality of the matriculation diploma are also positive and significant (except for math). While these are smaller than the effect for the first trimester, we cannot reject the hypothesis of equality of coefficients in this subset of outcomes.

Differences in magnitude of the estimated effects between females and males are not always significant, but all estimates point to the same pattern: exposure to better environmental conditions in utero starting from the first trimester dramatically improves outcomes for females relative to shorter exposure during the third trimester, but not for males. In addition, we observe a smaller but still positive and even sometimes significant effect for females in the second trimester, while there is no equivalent effect for males. However, while we do not observe an effect on schooling outcomes for males, it may well be the case that early exposure to better environmental conditions improves other outcomes for males—for example, behavioral outcomes, as we show in the next section.

Online Appendix Table A1 presents the results for a "pure" DID specification, where instead of all the controls added in equation (2) to net out seasonality effects, we include interactions between pre- and post- indicators, group indicators and treatment variables (the trimesters) using the following specification:

$$
\begin{aligned}
Y_i = {} & \alpha_0 + \alpha_1 FirstTrimester_i * Solomon_i * PostCohort_i \\
& + \alpha_2 SecondTrimester_i * Solomon_i * PostCohort_i + \alpha_3 FirstTrimester_i * PostCohort_i \\
& + \alpha_4 SecondTrimester_i * PostCohort_i + \alpha_5 FirstTrimester_i * Solomon_i \\
& + \alpha_6 SecondTrimester_i * Solomon_i + \alpha_7 FirstTrimester_i + \alpha_8 SecondTrimester_i \\
& + \alpha_9 PostCohort_i + \alpha_{10} PostCohort_i * Solomon_i + \alpha_{11} GroupA_i \\
& + \alpha_{12} Solomon_i + \alpha_{13} GroupA_i * PostCohort_i + \alpha_{14} FirstTrimester_i * GroupA_i \\
& + \alpha_{15} SecondTrimester_i * GroupA_i + \gamma X_i' + u_i.
\end{aligned} \tag{3}
$$

The treatment indicators were assigned according to day and month of birth only, meaning that first trimester equals 1 if the child was born between December 4, 1991, and February 15, 1992; the second trimester equals 1 if the child was born between August 28 and December 3, 1991; and the third trimester equals 1 if the child was born between May 27 and August 27, 1991. Online Appendix Table A1 reports estimates for the linear combination of $\alpha_1 + \alpha_3 + \alpha_5 + \alpha_7$, which is equivalent to β_1, and the linear combination of $\alpha_2 + \alpha_4 + \alpha_6 + \alpha_8$, which is equivalent to β_2. The results of the "pure" DID specification are very similar.

5.3 Effect on Additional Outcomes

5.3.1 Mid-Childhood Outcomes

Table 6 reports the results for fifth-grade test scores (column 1) and own behavior during elementary and middle school (column 2) for the baseline model, i.e. equation (1) for females (Panel A) and males (Panel B) in the same structure as Table 5. These estimates are important because they provide evidence on treatment effects midway between birth and the end of high school, solidifying a pattern to which we add in the next section evidence of treatment effects at adulthood.

To estimate treatment effects on test scores during elementary school, we regress the fifth-grade standardized test scores (by subject and year) on indicators of the first and second trimester while controlling for both parents' schooling, number of siblings, mother's age at birth, parents' age gap, and year and subject fixed effects using stacked data on all four subjects and weighting observations by the inverse of the number of times each student appears in the data. Consistent with our findings for high school achievement, we find beneficial effects of earlier exposure to the Israeli environment only for females. Test scores of females whose mothers arrived during the first trimester are 0.63 standard deviations (s.e.=0.199) higher than those of females whose mothers arrived in the third trimester. The effect for males is about half this magnitude, 0.32 standard deviations (s.e.=0.247), and not statistically significant.

Column 2 in Table 6 reports the estimated effect on an index that summarizes several measures of students' own behavior at school (measures of violent behavior, intimidation from violence of others, and social and learning satisfaction in school). We pool in this analysis the samples of fifth-, sixth- and seventh-graders. We use here the same specification as in column 1 with the addition of an indicator for grade. The estimates reported in column 2 of Table 6 suggest that exposure to Israeli environmental conditions from the first trimester of pregnancy has positive and significant effects on students' behavior at school relative to late exposure at the third trimester. This effect is evident for both females and males, with effect sizes of 0.235 (s.e. = 0.093) for girls and 0.206 (s.e. = 0.123) for boys, relative to arrival during the third trimester. Overall, these results suggest that the first trimester of pregnancy constitutes a critical period not only for cognitive development, but also for non-cognitive development.

5.3.2 Early Adulthood Outcomes

Here we observe post-secondary schooling and labor market outcomes by age 26. Table 7 presents estimates for outcomes measured at this age, following the same pattern as Table 6. The table shows that for females, the positive effect of earlier exposure to better environmental conditions in utero extends beyond high school to the labor market.

The effect of exposure from the first trimester is positive for females for most of the long-term human capital outcomes. In contrast, the impact for males is smaller, in some cases even negative, and not statistically significant. For females, exposure from the first trimester increases the likelihood of enrollment in any post-secondary institution by 12 percentage points (s.e.=0.063), and for enrollment in a university or academic college by 10 percentage points (s.e.=0.056). These gains represent a 35% and 53% increase relative to the outcome means for arrival in the third trimester. For males the effect is much smaller and insignificant. These effect sizes are similar to the treatment effect on high school outcomes. They are also larger than the effect of a variety of educational interventions in primary or secondary school, estimated based on the Israeli context. For example, they are larger than the effect of providing free school choice to middle school students (Lavy, 2015) or paying teachers based on their students' performance (Lavy, 2020).

Exposure to the Israeli environment from the first trimester also raises female employment between the ages of 23 and 25 by 9 percentage points (s.e.=0.034). Women whose mothers arrived in Israel during the first trimester accumulated on average a month and a half more work time (s.e.=0.462) compared to women whose mothers arrived during the third trimester. Their average monthly earnings are also higher, by 11% (NIS 406, s.e.=217.3). For males, none of the labor market outcomes are significant. It is important to note that because of Israel's compulsory military service, many individuals in our sample might be only entering the labor market at these ages. Therefore, we might not observe full-time employment and earnings, particularly for men. We also observe earnings at a relatively young age and not over the entire life cycle. On the other hand, there is no effect on receiving welfare benefits and on the likelihood of being married and having children by the age of 26. However, it is worth noting that the effect size for the likelihood of having children by age 26 for the first-trimester group compared to the third-trimester group is not small and might be noisy. In some specifications in our robustness checks (see Online Appendix Table A11 and Table A12) it is negative and significant.

5.3.3 Early Childhood Health Outcomes

So far, the results suggest that females who were exposed to better prenatal environmental conditions in Israel following their mothers' immigration during the first trimester of pregnancy had substantially higher educational outcomes in elementary school, middle school, and high school relative to those exposed to these conditions at later stages of pregnancy. These effects persist into early adulthood, where they manifest in higher attainment in post-secondary education and better labor market outcomes. The gains for males are smaller and appear mainly in better behavioral outcomes during childhood.

A possible mechanism for these effects is improved health outcomes (Black et al., 2007; Figlio et al., 2014; Bharadwaj et al., 2017; Neilson, 2018). We examine two health outcomes: birth weight and child mortality. However, the effects we obtain are relatively imprecise and are affected by data limitations (discussed below). Hence, we report these results in Table A2 and discuss them in depth only in the Online Appendix, section D.

The estimates for females are not significant, with opposite directions for birth weight and the likelihood of low birth weight. Actually, we find a positive, though insignificant, coefficient for those who arrived during the first trimester on the likelihood of low birth weight, which diverges from our findings of better cognitive outcomes. Estimates for males show some positive effect on birth weight from exposure in the second trimester, but no effects from the first trimester.

The second health outcome that we examine is child mortality (under age 6). The results show no effect of early exposure to the Israeli environment in utero on child mortality among females. On the other hand, we find that males who arrived in Israel during the first or second trimester were less likely to die relative to those who arrived during the last trimester. The reduction in mortality rates for males who arrived in the first trimester raises the concern that negative selection might explain the smaller or zero effect we estimate for males on later life outcomes, since the first-trimester group includes more "marginal" boys relative to the third. Therefore, in our analysis of later life outcomes we include all individuals who died and assign them the worst possible outcome (which is zero, given that all outcomes are either binary or count variables).[27]

[27] This imputation is in the spirit of Horowitz and Manski (2000).

6 Robustness Checks

6.1 Alternative Specifications

In Online Appendix Tables A4 and A5 we explore an alternative specification where we use gestational age (in weeks) at time of immigration as the main explanatory variable instead of the indicators for first and second trimester. Online Appendix Table A4 reports the results for the high school outcomes for the baseline sample and for the two-cohorts sample (i.e., including the sample of children who were born a year before our main sample). Online Appendix Table A5 reports the results for all other outcomes using only the baseline sample.

The estimates using gestational age for females are negative for most outcomes, indicating again beneficial effects for earlier exposure to better in-utero conditions. Estimates for males are small and not significant. One important difference from our main results is that we do observe some beneficial effects of early exposure to better environmental conditions on birth weight for both males and females: every additional week in utero in Israel as opposed to Ethiopia is associated with about a 5-gram increase in birth weight. Given the 25-week difference in median weeks of gestation between those who arrived in the first versus the third trimester, this would imply an effect of 75 grams for the first trimester.

To assess the robustness of our results to this linear specification in weeks of exposure to the Israeli environment, we estimated several additional models. First, we estimated a model based on higher-order polynomials instead of a linear term, but its fit to the data was inferior (lower adjusted R-squared and higher AIC values). Second, we estimated a model that included both a week linear effect and trimester dummies to examine whether the week effect could have additional explanatory power beyond the trimester indicators. Standard errors were large due to the high correlation between these covariates. However, the estimated effect sizes for the trimester dummies are almost unchanged and remain statistically significant, highlighting the nonlinear effect by trimester. Third, we tried specifications designed to formally search for a structural break in the data and obtained noisy and inconsistent estimates across outcomes, most likely because of the relatively small sample size (570 observations).

6.2 Placebo Test

To test for the validity of the research design, we estimate the model based on a sample with placebo treatment. The placebo treatment can be captured by immigrants to Israel who arrived around the time of Operation Solomon, but who came from a more developed part of the world where in-utero conditions at the time were similar to those in Israel. We implement this idea by focusing on a sample of immigrants who arrived in Israel during the massive immigration wave from the Former Soviet Union (FSU) in 1991–1992. Relevant evidence suggests that in-utero conditions in the Soviet Union (especially in those places where the immigrants lived) were relatively similar to those in Israel.[28] In addition, parental background characteristics among children of FSU immigrants are similar to those in the Israeli native population. For example, parental years of schooling among FSU immigrants at the time was about 11 years, close to the respective mean in the relevant Israeli population. Therefore, we expect to find no effect of treatment defined by length of gestation in Israel.

For this placebo test, we used the Ministry of Education online research room and collected data on all children whose mothers were pregnant upon arrival in Israel from the FSU in 1990–1992. The online research room provides access to all schooling outcomes as well as demographic information on students, including parents' schooling. Hence, we perform the placebo test only for high school outcomes. We define the treatment groups in the same way as the original treatment groups, and compute the gestational age of the child at immigration as the difference between the date of the mother's immigration and the child's birth date, subtracted from 40. Unlike Operation Solomon, immigration from FSU did not take place all at once; hence the treatment groups are not defined relative to a single specific immigration date. We can therefore control for cohort and month of birth effects in this sample.

Online Appendix Table A6 presents estimates based on equation (1) with year and birth month fixed effects, and with parents' schooling and number of siblings as controls.[29] The treatment estimates are much smaller (most are very close to zero), and all but one are insignificant, despite being more precisely measured relative to the results obtained for Ethiopian immigrants.

7 Alternative Interpretations and Measurement Issues

7.1 Alternative Interpretations

Our results show that individuals, in particular females, whose mothers arrived in Israel at earlier stages of pregnancy have better outcomes relative to those whose mothers arrived at more advanced stages of pregnancy. We interpret this as a positive impact of improved in-utero conditions. An al-

[28]More than 80% of the FSU immigrants came from the European republics, mainly Russia and Ukraine, and primarily from urban areas (Israel CBS, 2001). Infant and child mortality rates in these areas were 2% and 2.3% respectively (versus 1% and 1.2% in Israel and 12% and 20% in Ethiopia). Prenatal care in the FSU was also relatively similar to that in Israel (The World Bank, 1991). Until the fall of the Soviet Union, salt was routinely iodized by government policy (van der Haar et al., 2011). Also, while anemia in pregnant women has increased significantly in the FSU, this took place only after the collapse of the Soviet Union (Sedik et al., 2003).

[29]Because we only have administrative data from the Ministry of Education for the FSU sample, we cannot use the richer set of covariates that we used for the Ethiopian sample. However, since we find no evidence for differential selection in any of the available covariates, it is reasonable to assume that selection in other covariates or unobserved characteristics is also unlikely.

ternative interpretation is that mothers who arrived at an earlier stage of pregnancy had more time to adjust, prepare for the birth, and build social networks which would help them care for their newborns. We believe this explanation is unlikely, because all new Ethiopian immigrants were housed in absorption centers for at least 18–24 months. In these centers, they received assistance from social and health workers and interacted socially with others. Therefore, we can safely assume that all women who gave birth within our nine-month window upon arrival in Israel received the same postnatal care and had similar social networks. In addition, we show that this pattern is not observed among mothers who immigrated from the former Soviet Union at different stages of pregnancy.

To further rule out this alternative interpretation, we examine the association between child outcomes and mother's length of residence in Israel following immigration (in weeks) when the child was born, using a sample of children who were conceived in Israel shortly after their mothers immigrated from Ethiopia. Specifically, we examine outcomes for children born to Operation Solomon mothers 10 to 20 months after their mothers' arrival in Israel.[30] These results are presented in Appendix Table A6. The regressions include the same controls as our baseline model (equation 1). Even though the timing of conception in this sample cannot be seen as random, we believe that, if anything, the results should manifest upward bias, since waiting to conceive until one has gained familiarity and experience with Israeli life might be positively correlated with better unobservables. The evidence in Table A7 shows that mother's length of residence in Israel at the time the child was born is not associated with children's outcomes: the estimates are small, varying in sign, and not statistically significant. In fact, only 2 of the 18 estimates are statistically significant, and they are in the opposite direction than expected, showing negative associations between mothers' length of residence and both (i) birth weight for males and and (ii) chances of completing high school for females. This evidence further mitigates concerns that our results are driven by the longer residence in Israel of mothers who arrived during the first trimester of pregnancy.

Stress is another potential confounding factor in our results. Children in utero at immigration could be negatively affected by maternal stress during this event. The existing literature shows detrimental effects of stress for some outcomes but not for others, and there is little evidence regarding whether gestational age at the time of shock matters.[31] Some medical studies address

[30] We include in this sample only children conceived less than a year after the immigration date to ensure that the mothers were likely all still in absorption centers during the pregnancy, and therefore received similar prenatal care. We perform this analysis only for the high school outcomes and early childhood health outcomes, since we observe these children only in our data from the CBS.

[31] Aizer et al. (2016) and Persson and Rossin-Slater (2018) find that in-utero exposure to maternal stress has detrimental effects on children's mental health. Aizer et al. (2016) find no effect on birth outcomes but do find effects on cognitive outcomes at age 7. Black et al. (2016) explore parental loss during pregnancy and find a small adverse effect on birth outcomes, but no effect on education and earnings. None of these studies examine the differential effect of maternal stress by gestational age.

this question. Glynn et al. (2001) report that age of gestation at birth is shorter for mothers exposed to an earthquake in their first trimester relative to mothers exposed to such trauma in their third trimester. Laplante et al. (2004) and King et al. (2012) find that high levels of prenatal stress in early pregnancy have a negative effect on brain development, resulting in lower intellectual and language abilities at toddler age.[32] There is also a stream of literature in economics that studies the effect of maternal psychological distress caused by violence and civil conflict on birth outcomes. Findings from this literature suggest that the most significant effect comes from psychological distress in the early stages of pregnancy (Camacho, 2008; Aizer, 2011; Mansour and Rees, 2012; Brown et al., 2014; Quintana-Domeque and Ródenas-Serrano, 2017). If the effect of stress during immigration follows the same pattern, we should thus see detrimental (rather than beneficial) effects from arrival during the first trimester.

Another finding which alleviates the concern that our results are caused by differential exposure to stress is the lack of any difference in sex ratios between children born following arrival in the first and third trimesters. This result is in contrast to evidence showing that maternal stress increases the chances of miscarriage for males (see, e.g., Liu et al., 2015; Kraemer, 2000). We also find no differences in birth weight by gestational age upon arrival in Israel, even though the literature shows that maternal stress also causes lower birth weight (King et al., 2012).

7.2 Measurement Issues

Additional challenges to our design relate to measurement issues. We compute gestational age based on date of birth because we do not have access to clinical pregnancy records. This implies that we might have misclassified children who were born preterm. This measurement error is a concern if misclassification or preterm births are more likely following arrival in a particular trimester. We suspect that this is not the case, since we find no association between the trimester of gestation upon arrival in Israel and birth weight, which is a good proxy for preterm births. However, to further examine this concern, Online Appendix Table A8 replicates results of the baseline sample reported in Tables 5 and A2 after excluding children with very low birth weight (<2500gr) and children with missing values in birth weight—altogether, 8.7% of the sample. These are children who are more likely to have been born premature, and therefore to have been assigned to the wrong trimester on immigration day. The results are very similar to those presented in Tables 5 and A2.

A second, related concern regarding measurement error in gestational age is that we might have included in the first trimester some children who were conceived in Israel and were born preterm. Children conceived in Israel who were born preterm are more likely to have been born

[32]These findings are consistent with studies on non-human primates, which show a stronger detrimental effect on birth weight and neuromotor functioning of maternal stress during early gestation compared to mid-late gestation (Schneider et al., 1999).

in late January or early February 1992. We therefore stratify the first trimester into three groups, namely weeks 2–4, weeks 5–8, and weeks 9–12 of gestation, and estimate equation (1) in light of this stratification. Estimates reported in Online Appendix Table A9 show that the beneficial effects of first-trimester arrival among females do not particularly derive from the first weeks after conception, reducing concerns about this measurement problem.

We further examine the robustness of our results for misclassification of births by trimester by re-estimating our two main models after imposing alternative restrictions on the sample. To save space, we report here the results only for females, given that most of the effects of early exposure are manifested primarily in this gender. We first estimate our models while excluding births where immigration occurred during the first two weeks of each trimester separately, and then for all three together (see Online Appendix Table A10). These restrictions exclude possible late-term or post-term births. Next, we exclude from the sample births where immigration took place in the last two weeks of each trimester, thus reducing the likelihood of misclassification of preterm births (see Online Appendix Table A11). Last, we modify the sample by re-assigning births where immigration took place in the first (last) two weeks of each trimester to the previous (next) trimester group (see Online Appendix Table A12). Overall, the estimates from the samples based on these various restrictions are very similar to those obtained in the baseline results, suggesting that our results are not driven by misclassification.

Another concern is that we do not observe in our data miscarriages or stillbirths. If these events were more likely to occur among mothers who arrived in Israel during the first trimester, they may have caused the first-trimester sample to be positively selected. If this is the case, we expect the mean birth weight for the first-trimester group to be higher than that for the other two, which is not the case. Second, since males are more likely to be miscarried or die prematurely in hard times, the existence of more miscarriages and stillbirths among mothers who arrived in the first trimester would lead to a lower sex ratio (males relative to females) in the first-trimester sample relative to the other two. However, as we showed in section 5.1, the sex ratios of children in the first- and third-trimester samples are equal. Third, as noted above, there are no significant differences in the share of births by calendar week between our main analysis sample and the two comparison group samples. Last, we believe that if anything, the better environmental conditions upon arrival in Israel should have lowered the incidence of miscarriage among women who arrived at earlier stages of pregnancy relative to those who arrived at a later stage, as found in the mortality analysis. This would lead to the inclusion of more marginal children born to mothers who arrived in the first trimester, which would work against the positive impact on longer-term cognitive outcomes that we observe for this group.

We further assess the possible incidence of miscarriage by examining mother's age at birth among first-born children and birth spacing (number of months between two births) for laterborns.[33] In Online Appendix Table A13 we report estimates from regressions similar to equation (1) and (2) with mother's age at birth or birth spacing as the dependent variable. Mothers of first-born females from the first-trimester group are younger than those from the third-trimester group.[34] At higher parities, we do not observe differences in birth spacing between children from the first- and third-trimester groups. For males, there are no significant differences between children from the first- and third-trimester groups in mother's age at parity one, but we observe a tighter spacing between births at higher parities for children who arrived during the first trimester.

Overall, the evidence reported in this table could be consistent with a pattern of fewer miscarriages for mothers who arrived in Israel during the first trimester. Therefore, more "marginal" children may be included in the sample of mothers who immigrated during the first trimester. This scenario seems less likely when viewed against our finding of beneficial effects of immigration during the first trimester among females. However, it might explain the zero effect among males.

8 Conclusions

This paper examines how improvements in prenatal conditions from the level found in a developing country to that typically observed in a developed country can affect individual outcomes in childhood and early adulthood. Although most immigrants from poor countries in Africa and Asia experience dramatic changes in environment upon their arrival in a developed country, no evidence exists as to the benefits to in-utero children. The present analysis is based on exogenous variation in environmental conditions in utero caused by the sudden immigration of Ethiopian Jews to Israel in May 1991. Individuals who were already in utero on the immigration date were exposed to better environmental conditions in terms of nutrition, access to health care services and standard of living upon arrival in Israel. Some children were exposed to these better conditions from the early weeks of gestation, while others were exposed only in the last stage of their mother's pregnancy. We exploit this variation to examine the effect of weeks of exposure in utero to better environmental conditions on early life health outcomes, elementary, middle and high school outcomes, and early adulthood outcomes.

The results suggest that females who were exposed to better environmental conditions in Israel due to immigration during the first trimester of pregnancy had substantially improved educational outcomes in elementary school, middle school, and high school relative to those exposed to these conditions at later stages of pregnancy. These improved educational outcomes include better behavioral outcomes and test scores during elementary and middle school, lower likelihood of grade

[33] Miscarriages would mechanically increase mother's age at first birth and birth spacing for subsequent births.

[34] Note that there are no differences in mother's age at birth by trimester grouping for the full sample of children (see Table 4).

repetition and dropout in high school, higher likelihood of obtaining a matriculation diploma, and completing a higher-quality matriculation study program in high school. These effects persist into early adulthood and manifest in higher attainment in post-secondary education and better labor market outcomes. The results are robust to the use of alternative comparison groups designed to control for seasonality of birth and cohort effects. The benefits for males are smaller and are only manifested in lower child mortality and better behavioral outcomes during elementary and middle school.

This paper adds to the growing economic literature investigating the fetal origins hypothesis by providing compelling evidence from an unusual natural experiment. To the best of our knowledge this is the first paper that attempts to estimate the effect of different environmental conditions in utero caused by immigration, especially from a very poor African country to a Western economy. As such, our estimates can perhaps be viewed as an upper bound on what a full prenatal care program might be able to achieve in low-income settings. The implications of these findings are also relevant for many industrialized countries that experience large immigration waves from developing countries. In addition, our findings can shed light on the early origins of gaps in human capital and health outcomes between developing and developed countries.

We also provide evidence for a critical period in prenatal development and examine the effect on different outcomes at different points in life between early life and adulthood. Our findings show that exposure to better prenatal conditions from the first trimester of pregnancy has large and important benefits for females that persist beyond childhood and are reflected in human capital accumulation and earnings capacity in the long run. Showing how the effect manifests over a wide set of outcomes during child development, adolescence, and early adulthood sheds some light on how policies can shape individuals' trajectories in life.

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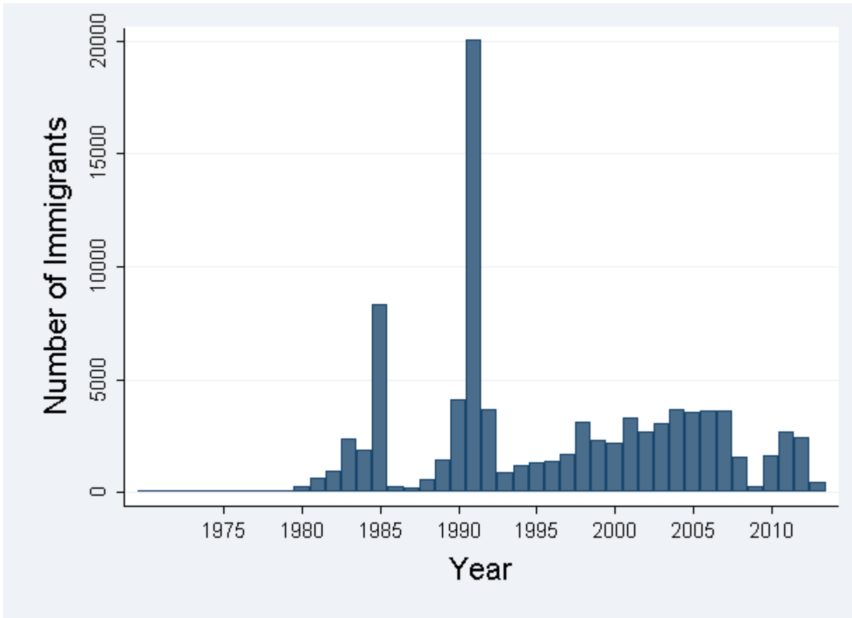
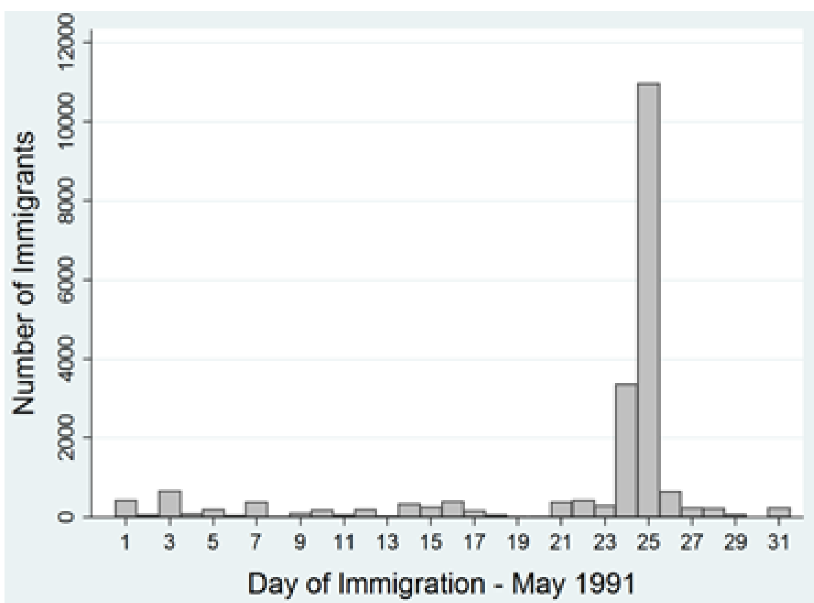
Figure 1: Immigration of Ethiopian Jews to Israel, 1975–2010



Notes: Distribution of Ethiopian immigrants to Israel by year. Source: Israel Central Bureau of Statistics.

Figure 2: Immigration of Ethiopian Jews to Israel, May 1991



Notes: Distribution of Ethiopian immigrants to Israel in May 1991 by date. Source: Israel Central Bureau of Statistics.

Figure 3: Definition of the Three Trimester Groups

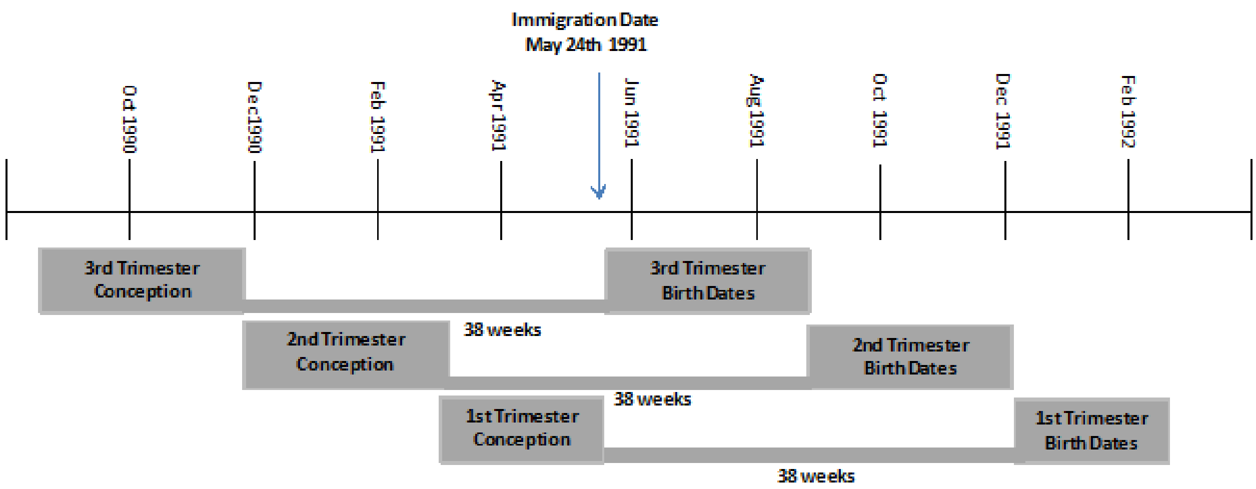
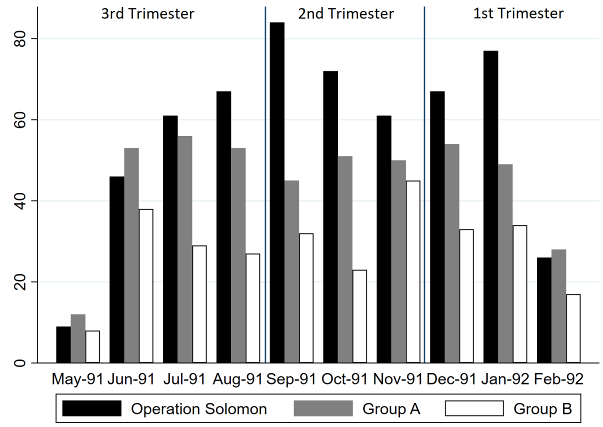
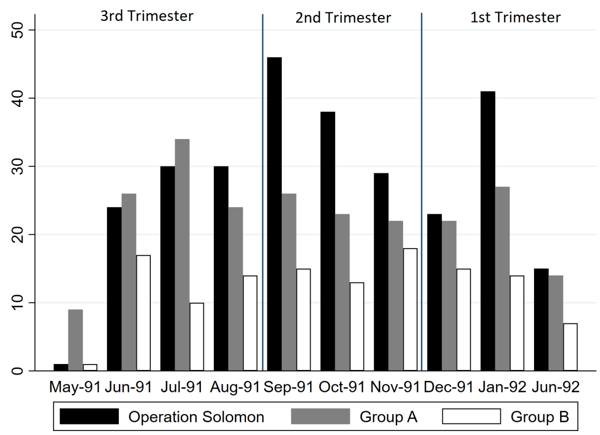


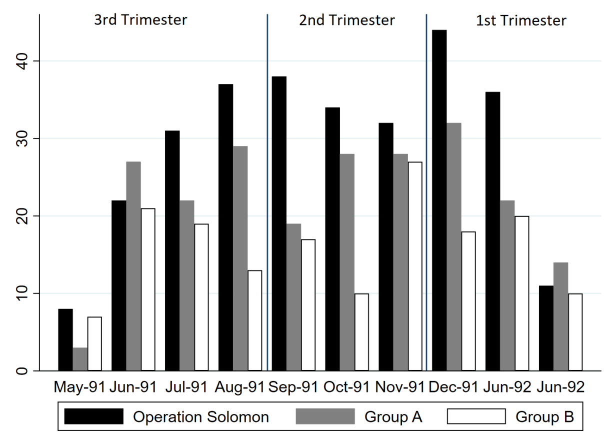
Figure 4: Birth Distribution of Main Sample and Two Comparison Groups



(a) All



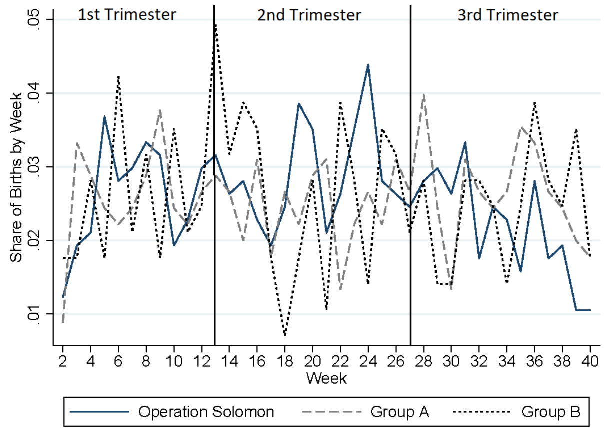
(b) Females



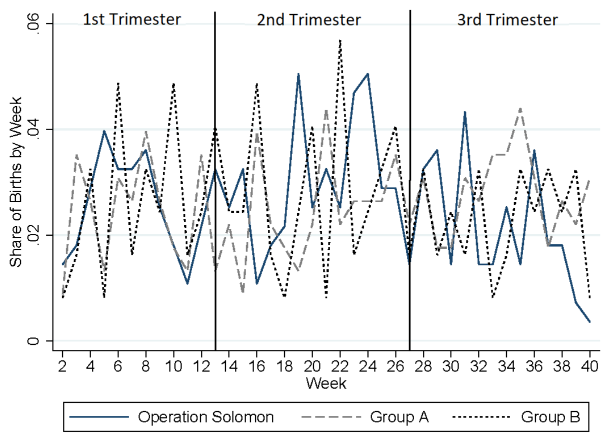
(c) Males

Notes: Frequency of births in the main analysis sample (Operation Solomon children) and in the two comparison groups, by month of birth and by trimester of immigration.

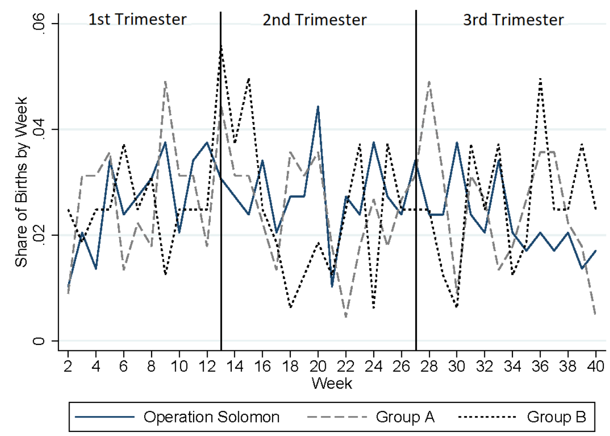
Figure 5: Share of Births by Gestational Week on Date of Immigration (May 24 or 25, 1991) for Main Sample and Two Comparison Groups



(a) All



(b) Females



(c) Males

Notes: The share of births by gestational week upon immigration to Israel (May 24 or 25, 1991) for the main analysis sample (Operation Solomon children) and the two comparison groups. Vertical lines denote the trimester groups.

Table 1. Descriptive Statistics: Background Characteristics

	Main Sample			Comparison Samples—Ethiopian Origin					
	"Operation Solomon" Individuals			Group A Individuals Conceived in Israel (parents immigrated before 1989)			Group B Ethiopian-Born Individuals (parents immigrated after 1991)		
	All	Females	Males	All	Females	Males	All	Females	Males
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mother's age at birth	30.55	30.55	30.54	28.81	29.25	28.37	27.49	25.81	28.78
	[8.887]	[8.924]	[8.868]	[7.022]	[6.905]	[7.127]	[7.784]	[7.635]	[7.674]
Father's age at birth	41.48	41.27	41.68	35.79	36.13	35.44	37.28	35.36	38.74
	[12.16]	[12.19]	[12.16]	[9.412]	[9.428]	[9.404]	[11.27]	[11.18]	[11.16]
Mother's age at first birth	23.04	22.91	23.17	21.34	21.54	21.13	20.97	20.16	21.59
	[5.415]	[5.505]	[5.335]	[4.140]	[4.225]	[4.051]	[4.812]	[4.667]	[4.844]
Parents' age gap	10.94	10.71	11.14	6.978	6.885	7.071	9.783	9.548	9.963
	[7.384]	[7.389]	[7.385]	[5.827]	[5.818]	[5.847]	[6.643]	[6.692]	[6.620]
Number of siblings	5.304	5.318	5.290	4.350	4.282	4.420	5.035	4.919	5.123
	[1.913]	[1.965]	[1.866]	[1.863]	[1.912]	[1.815]	[1.704]	[1.685]	[1.719]
Birth order	3.658	3.671	3.645	3.406	3.374	3.438	3.343	2.992	3.611
	[2.207]	[2.159]	[2.254]	[1.902]	[1.911]	[1.898]	[1.881]	[1.906]	[1.822]
Birth spacing (years to the next birth)	2.565	2.573	2.559	2.926	2.811	3.042	2.524	2.402	2.617
	[2.187]	[2.263]	[2.116]	[2.803]	[2.707]	[2.898]	[1.790]	[1.734]	[1.830]
Father's years of schooling	1.316	1.509	1.133	4.016	4.115	3.915	1.392	1.242	1.506
	[3.097]	[3.319]	[2.864]	[5.300]	[5.374]	[5.234]	[3.425]	[3.072]	[3.678]
Mother's years of schooling	1.433	1.560	1.314	3.867	3.890	3.844	1.199	1.032	1.327
	[3.275]	[3.312]	[3.241]	[5.027]	[4.979]	[5.086]	[3.088]	[2.880]	[3.241]
Family income, 1995	16,280	16,035	16,512	47,210	49,781	44,606	6,359	7,432	5,539
	[14,336]	[14,223]	[14,461]	[33,946]	[37,156]	[30,210]	[11,878]	[12,669]	[11,206]
SES of the mother's first locality of residence upon immigration	-0.028	-0.037	-0.020	-0.009	-0.012	-0.006	0.160	0.184	0.141
	[0.543]	[0.526]	[0.560]	[0.553]	[0.541]	[0.565]	[0.577]	[0.572]	[0.582]
Observations	570	277	293	451	227	224	284	124	162

Notes: Standard deviations are presented in brackets. Individuals in all samples were born between May 27, 1991, and February 15, 1992. Main sample comprises individuals born in Israel whose parents immigrated to Israel in Operation Solomon (May 24-25, 1991). Group A comprises individuals born in Israel whose parents immigrated before 1989 (second-generation immigrants from Operation Moses). Group B comprises individuals born in Ethiopia who immigrated to Israel between 1992 and 2000 (post-Operation Solomon immigrants).

Table 2. Means and Standard Deviations of Outcome Variables (Israel CBS Data Source)

	Main Sample			Comparison Samples—Ethiopian Origin					
	"Operation Solomon" Individuals			Group A Individuals Conceived in Israel parents immigrated before 1989			Group B Ethiopian-Born Individuals parents immigrated after 1991		
	All	Females	Males	All	Females	Males	All	Females	Males
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
I. High School Outcomes									
No grade repetition (6th–12th grade)	0.807	0.884	0.734	0.827	0.907	0.746	0.776	0.847	0.722
	[0.395]	[0.320]	[0.443]	[0.379]	[0.290]	[0.437]	[0.418]	[0.362]	[0.449]
Completed 12th grade	0.851	0.921	0.785	0.878	0.947	0.808	0.836	0.919	0.772
	[0.357]	[0.271]	[0.412]	[0.328]	[0.224]	[0.395]	[0.371]	[0.273]	[0.421]
Obtained a matriculation diploma	0.300	0.397	0.208	0.359	0.463	0.254	0.301	0.403	0.222
	[0.459]	[0.490]	[0.407]	[0.480]	[0.500]	[0.437]	[0.459]	[0.493]	[0.417]
Total matriculation units	11.30	14.18	8.573	12.95	16.00	9.871	11.73	14.72	9.444
	[11.04]	[10.97]	[10.42]	[10.88]	[10.50]	[10.40]	[11.30]	[11.29]	[10.79]
Math matriculation units (0 to 5)	1.258	1.520	1.010	1.483	1.841	1.121	1.238	1.556	0.994
	[1.509]	[1.545]	[1.432]	[1.507]	[1.538]	[1.388]	[1.544]	[1.609]	[1.451]
English matriculation units (0 to 5)	1.949	2.422	1.502	2.399	2.916	1.875	1.885	2.347	1.531
	[1.880]	[1.827]	[1.822]	[1.910]	[1.749]	[1.927]	[1.844]	[1.772]	[1.825]
II. Early Life Health Outcomes									
Birth weight (*gr*)	3,099	3,043	3,152	3,130	3,111	3,149			
	[460.2]	[479.2]	[435.5]	[540.6]	[520.8]	[560.6]			
Low birth weight ($<$2500 *gr*)	0.075	0.091	0.059	0.087	0.067	0.108			
	[0.263]	[0.288]	[0.236]	[0.283]	[0.250]	[0.311]			
Child mortality (by age 6)	0.014	0.011	0.017	0.009	0.004	0.013			
	[0.118]	[0.104]	[0.130]	[0.094]	[0.066]	[0.115]			
Observations	570	277	293	451	227	224	284	124	162

Notes: Standard deviations are presented in brackets. Individuals in all samples were born between May 27, 1991, and February 15, 1992. Main sample comprises individuals born in Israel whose parents immigrated to Israel in Operation Solomon (May 24-25, 1991). Group A comprises individuals born in Israel whose parents immigrated before 1989 (second-generation immigrants from Operation Moses). Group B comprises individuals born in Ethiopia who immigrated to Israel between 1992 and 2000 (post-Operation Solomon immigrants). Means and standard deviations for early life health outcomes are reported only for individuals born in Israel.

Table 3. Means and Standard Deviations of Outcome Variables (NII Data Source)

	Main Sample		
	"Operation Solomon" Children		
	All	Females	Males
	(1)	(2)	(3)
I. GEMS Outcomes			
GEMS test scores	0.000	0.188	-0.210
	[1.000]	[0.896]	[1.056]
Own behavior at school	0.012	0.085	-0.072
	[0.477]	[0.559]	[0.476]
II. Long-Term Human Capital Outcomes			
i.By Age 26			
Enrolled in any post-secondary institution (1 = Yes, 0 = No)	0.251	0.358	0.150
	[0.434]	[0.480]	[0.358]
Enrolled in university or collage (1 = Yes, 0 = No)	0.190	0.291	0.094
	[0.393]	[0.455]	[0.293]
Received any welfare benefits (1 = Yes, 0 = No)	0.118	0.125	0.112
	[0.323]	[0.332]	[0.316]
ii.Between Ages 23 and 25			
Employed (1 = Yes, 0 = No)	0.902	0.924	0.882
	[0.297]	[0.266]	[0.322]
Employed or studying (1 = Yes, 0 = No)	0.908	0.931	0.887
	[0.288]	[0.253]	[0.317]
Annual months worked	9.117	9.411	8.839
	[4.044]	[3.849]	[4.204]
Monthly earnings (NIS)	4,225	3,816	4,612
	[2,320]	[2,010]	[2,522]
Monthly earnings conditional on employment (NIS)	4,682	4,132	5,227
	[1,957]	[1,752]	[1,997]
III. Marriage and Childbearing by Age 26			
Married (1 = Yes, 0 = No)	0.095	0.151	0.042
	[0.294]	[0.359]	[0.201]
Children (1 = Yes, 0 = No)	0.097	0.144	0.052
	[0.296]	[0.352]	[0.223]
Observations	557	271	286

Notes: Standard deviations are presented in brackets. Individuals in the sample were born between May 27, 1991, and February 15, 1992. Sample comprises individuals born in Israel whose parents immigrated in Operation Solomon (May 24-25, 1991). GEMS test score is the mean z-score (by year and subject) in math, Hebrew, science and English. It is based on a sample of 956 tests (504 from females and 452 from males) taken by 260 fifth-grade students (135 females and 125 males), out of 557 students in the sample. Own behavior at school is the mean of the standardized answers for the seven items that relate to students' feelings or self-reported behavior in the student questionnaire. It is based on a sample of 576 questionnaires (307 from females and 269 from males) filled in by 470 fifth- to seventh-grade students (269 females and 201 males), out of 557 students in the sample. Long-term human capital outcomes between age 23 and 25 are observed for each individual once at each age. Hence the sample for these outcomes is a panel of 1,671 observations.

Table 4. Differences in Observable Characteristics Between Trimester Groups

	All				Females				Males			
	1st Trim.	Difference (t-test)			1st Trim.	Difference (t-test)			1st Trim.	Difference (t-test)		
	Mean, SD	1st-2nd	1st-3rd	2nd-3rd	Mean, SD	1st-2nd	1st-3rd	2nd-3rd	Mean, SD	1st-2nd	1st-3rd	2nd-3rd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Female	0.472	-0.043	0.012	0.055								
	[0.501]	(0.051)	(0.055)	(0.050)								
Mother's age at birth	30.88	0.575	0.308	-0.268	31.41	0.800	1.741	0.942	30.40	0.427	-0.937	-1.363
	[9.777]	(0.982)	(1.002)	(0.885)	[9.752]	(1.558)	(1.476)	(1.091)	[9.832]	(1.032)	(1.293)	(1.235)
Father's age at birth	40.80	-1.023	-0.846	0.176	41.20	-0.236	0.111	0.347	40.45	-1.792	-1.679	0.113
	[12.51]	(1.341)	(1.326)	(1.104)	[12.36]	(2.099)	(2.135)	(1.707)	[12.71]	(1.352)	(1.592)	(1.516)
Mother's age at first birth	23.37	0.424	0.509	0.085	22.91	-0.250	0.377	0.627	23.79	1.063	0.641	-0.422
	[6.058]	(0.661)	(0.549)	(0.596)	[6.147]	(0.951)	(0.905)	(0.732)	[5.982]	(0.744)	(0.716)	(0.733)
Parents' age gap	9.925	-1.598***	-1.154	0.444	9.789	-1.036	-1.630	-0.595	10.05	-2.218***	-0.742	1.476
	[6.342]	(0.570)	(0.688)	(0.608)	[6.289]	(0.874)	(1.108)	(1.023)	[6.423]	(0.773)	(0.887)	(0.913)
Number of siblings	5.329	0.020	0.056	0.036	5.289	-0.194	0.191	0.385	5.365	0.241	-0.056	-0.297
	[1.942]	(0.190)	(0.209)	(0.184)	[1.910]	(0.251)	(0.268)	(0.229)	[1.981]	(0.229)	(0.277)	(0.269)
Birth order	3.578	-0.070	-0.167	-0.096	3.842	0.150	0.361	0.210	3.341	-0.261	-0.627*	-0.367
	[2.215]	(0.235)	(0.283)	(0.253)	[2.209]	(0.329)	(0.309)	(0.271)	[2.207]	(0.228)	(0.373)	(0.354)
Birth spacing	2.640	0.217	-0.045	-0.262	2.893	0.486	0.374	-0.112	2.415	-0.026	-0.412	-0.386
(years to the next birth)	[2.136]	(0.251)	(0.308)	(0.277)	[2.477]	(0.390)	(0.459)	(0.327)	[1.763]	(0.229)	(0.281)	(0.317)
Father's years of schooling	1.255	-0.252	0.135	0.387	1.000	-0.775	-0.593	0.182	1.482	0.261	0.767**	0.505
	[2.866]	(0.291)	(0.314)	(0.265)	[2.638]	(0.443)	(0.476)	(0.503)	[3.054]	(0.366)	(0.348)	(0.312)
Mother's years of schooling	1.137	-0.644**	-0.108	0.537	0.855	-1.036**	-0.873**	0.163	1.388	-0.275	0.557	0.832*
	[2.908]	(0.298)	(0.326)	(0.313)	[2.647]	(0.410)	(0.419)	(0.514)	[3.117]	(0.486)	(0.465)	(0.412)
Family income (NIS), 1995	17,156	1,150.	1,315	164.2	16,010	-546.1	721.4	1,267	18,182	2,760	1,868	-891.5
	[15,200]	(1,591)	(1,600)	(1,471)	[14,294]	(2,226)	(2,107)	(1,840)	[15,981]	(1,824)	(2,063)	(1,778)
SES of the mother's first	-0.065	-0.062	-0.036	0.026	-0.130	-0.148*	-0.101	0.047	-0.006	0.018	0.023	0.005
locality of residence upon	[0.547]	(0.063)	(0.052)	(0.057)	[0.498]	(0.081)	(0.063)	(0.073)	[0.584]	(0.090)	(0.086)	(0.087)
immigration												
Joint Significance of all Covariates												
F Statistic		2.48	1.59	0.53		2.48	1.54	0.87		4.02	1.92	1.09
P-value		0.033	0.169	0.854		0.033	0.185	0.573		0.002	0.092	0.404

Notes: Means and standard deviations (in brackets) of first-trimester group are presented in columns 1, 5 and 9 for all individuals, and for females and males respectively. Columns 2, 6 and 10 report differences in means and standard errors clustered at week of pregnancy between the first- and second-trimester groups for all individuals, and for females and males respectively. Columns 3, 7 and 11 report differences in means and standard errors clustered at week of pregnancy between the first- and third-trimester groups for all individuals, and for females and males respectively. Columns 4, 8 and 12 report differences in means and standard errors clustered at week of pregnancy between the second- and third-trimester groups for all individuals, and for females and males respectively. The last two rows report F statistics and p-values for joint significance of all covariates. First-trimester group includes 161 individuals (76 females and 85 males) born between December 4, 1991, and February 15, 1992; second-trimester group includes 233 individuals (120 females and 113 males) born between August 28 and December 3, 1991; and third-trimester group includes 176 individuals (81 females and 95 males) born between May 27 and August 27, 1991.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5. Estimated Effect of Prenatal Environment on High School Outcomes by Gender

	No Grade Repetition (6th—12th grade)		Completed 12th Grade		Obtained a Matriculation Diploma		Total Matriculation Units		Math Matriculation Units		English Matriculation Units	
	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Females												
1st-trimester	0.164***	0.168***	0.074*	0.075*	0.148*	0.178**	4.527***	4.988***	0.599**	0.676***	0.741***	0.820***
	(0.045)	(0.044)	(0.042)	(0.040)	(0.088)	(0.082)	(1.686)	(1.371)	(0.245)	(0.216)	(0.287)	(0.238)
2nd-trimester	0.104**	0.095**	0.040	0.031	0.103	0.095	3.467**	3.152**	0.377	0.325	0.649***	0.626***
	(0.045)	(0.044)	(0.042)	(0.040)	(0.092)	(0.082)	(1.556)	(1.438)	(0.233)	(0.221)	(0.226)	(0.220)
P-value: 1st = 2nd	0.078	0.042	0.346	0.233	0.552	0.275	0.485	0.183	0.287	0.062	0.711	0.392
3rd-trimester Mean and SD	0.802 [0.401]		0.889 [0.316]		0.309 [0.465]		11.51 [10.68]		1.198 [1.528]		1.938 [1.880]	
Panel B. Males												
1st-trimester	0.028	0.020	0.005	0.005	0.056	0.032	1.297	1.060	0.156	0.111	0.182	0.160
	(0.066)	(0.070)	(0.059)	(0.061)	(0.052)	(0.055)	(1.236)	(1.290)	(0.202)	(0.191)	(0.199)	(0.243)
2nd-trimester	-0.024	-0.026	-0.020	-0.017	0.015	0.001	0.447	0.344	0.163	0.129	-0.020	-0.023
	(0.059)	(0.060)	(0.048)	(0.050)	(0.051)	(0.051)	(1.177)	(1.174)	(0.207)	(0.174)	(0.152)	(0.210)
P-value: 1st = 2nd	0.372	0.466	0.665	0.686	0.409	0.547	0.438	0.490	0.969	0.922	0.294	0.357
3rd-trimester Mean and SD	0.737 [0.443]		0.789 [0.410]		0.189 [0.394]		8.116 [9.882]		0.926 [1.362]		1.463 [1.737]	
Panel C. P-value for equality of the coefficient between females and males												
1st-trimester	0.129	0.116	0.369	0.357	0.351	0.108	0.091	0.008	0.165	0.037	0.079	0.027
2nd-trimester	0.103	0.123	0.345	0.392	0.358	0.278	0.091	0.058	0.439	0.405	0.010	0.014

Notes: Standard errors reported in parentheses are clustered at week of pregnancy for the OLS regressions and at week and year of birth for the DID regressions. Odd columns report estimates for β_1 and β_2 of equation (1) and even columns report estimates for β_1 and β_2 of equation (2). Both were estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel, and birth order. The two-cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) controls also for cohort, dummies for the comparison groups, indicator for born in Ethiopia, and month of birth fixed effects. The baseline sample includes 570 individuals (277 female and 293 males) born between May 27, 1991, and February 15, 1992, and the two-cohorts sample includes 2,365 individuals (1,146 females and 1,210 males) born either between May 27, 1991, and February 15, 1992, or between May 27, 1990, and February 15, 1991. The baseline category is arrival in Israel in the third trimester of pregnancy.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6. Estimated Effect of Prenatal Environment on Test Scores and Own Behavior in Elementary and Middle School

	GEMS Test Scores (Fifth Grade)	Own Behavior at School (Fifth to Seventh Grade)
	(1)	(2)
Panel A. Females		
1st-trimester	0.631***	0.235**
	(0.203)	(0.096)
2nd-trimester	0.294**	0.007
	(0.141)	(0.073)
P-value: 1st = 2nd	0.048	0.007
3rd-trimester	-0.026	0.026
Mean and SD	[0.939]	[0.494]
Panel B. Males		
1st-trimester	0.314	0.206*
	(0.242)	(0.118)
2nd-trimester	-0.081	-0.032
	(0.202)	(0.107)
P-value: 1st = 2nd	0.089	0.060
3rd-trimester	-0.187	-0.094
Mean and SD	[0.954]	[0.650]
Panel C. P-value for equality of the coefficient between females and males		
1st-trimester	0.358	0.812
2nd-trimester	0.136	0.767

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates for β_1 and β_2 of equation (1), estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check for the equality of coefficients of females and males. The dependent variable in column 1 is the standardized GEMS test score (by year and subject) of fifth-grade students in math, Hebrew, science and English. The sample in column 1 stacks for all GEMS subjects and includes 956 tests (504 from females and 452 from males) taken by 260 fifth-grade students (135 females and 125 males), out of 557 overall in the sample. Estimates are weighted by the inverse number of appearances of each student. Controls in column 1 include both parents' years of schooling, number of siblings, mother's age at birth, parents' age gap, test year fixed effects, and indicators for the subject of the test. The dependent variable in column 2 is the mean of the standardized answers for the seven items that relate to students' feelings or self-reported behavior in the student questionnaire. The sample in column 2 pools data for students from the fifth, sixth and seventh grades (the same student may appear more than once) and includes 576 questionnaires (307 from females and 269 from males) filled in by 470 students (269 females and 201 males), out of 557 students from the sample. Estimates are weighted by the inverse number of appearances of each student. Controls in column 2 include both parents' years of schooling, number of siblings, mother's age at birth, parents' age gap, and year and grade dummies. The baseline category is arrival in Israel in the third trimester of pregnancy.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7. Estimated Long-Term Effects of Prenatal Environment: Post-Secondary Schooling, Labor Market, Marriage and Childbearing

	Post-secondary Schooling and Welfare Recipiency, Ages 18–26 (1 = Yes, 0 = No)			Labor Market Outcomes Ages 23–25					Marriage and Childbearing by Age 26 (1 = Yes, 0 = No)	
	Any Post-secondary Enrollment	University or College Enrollment	Welfare Recipiency	Employed (1 = Yes, 0 = No)	Employed or Studying (1 = Yes, 0 = No)	Annual Months Worked	Monthly Earnings (NIS)	Monthly Earnings Conditional on Employment	Married	Children
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. Females										
1st-trimester	0.117*	0.101*	0.018	0.090***	0.073**	1.495***	406.2*	-46.18	-0.026	-0.072
	(0.063)	(0.056)	(0.045)	(0.034)	(0.031)	(0.462)	(217.3)	(243.2)	(0.052)	(0.054)
2nd-trimester	0.079	0.114**	-0.002	0.063*	0.052*	0.656	225.0	-69.91	-0.28	-0.019
	(0.058)	(0.054)	(0.052)	(0.034)	(0.031)	(0.493)	(219.9)	(242.9)	(0.041)	(0.054)
P-value: 1st = 2nd	0.612	0.846	0.710	0.357	0.457	0.039	0.326	0.884	0.963	0.318
3rd-trimester Mean and SD	0.265	0.187	0.113	0.871	0.883	8.708	3,636	4,175	0.175	0.163
	[0.443]	[0.393]	[0.318]	[0.336]	[0.322]	[4.342]	[2,171]	[1,776]	[0.382]	[0.371]
Panel B. Males										
1st-trimester	0.032	0.008	0.037	-0.010	-0.011	-0.516	51.769	176.1	0.023	0.021
	(0.039)	(0.034)	(0.032)	(0.039)	(0.039)	(0.500)	(276.7)	(244.4)	(0.021)	(0.026)
2nd-trimester	0.096*	0.070*		-0.000	0.013	-0.310	-325.7	-296.3	0.065	0.032
	(0.054)	(0.040)	(0.032)	(0.035)	(0.031)	(0.480)	(259.3)	(216.3)	(0.024)	(0.031)
P-value: 1st = 2nd	0.216	0.103	0.825	0.795	0.499	0.634	0.056	0.020	0.135	0.726
3rd-trimester Mean and SD	0.106	0.064	0.096	0.872	0.872	8.954	4,610	5,285	0.011	0.032
	[0.310]	[0.246]	[0.296]	[0.334]	[0.334]	[4.248]	[2,429]	[1,786]	[0.103]	[0.177]
Panel C. P-value for equality of the coefficient between females and males										
1st-trimester	0.288	0.139	0.730	0.079	0.110	0.012	0.381	0.541	0.431	0.168
2nd-trimester	0.805	0.519	0.426	0.220	0.357	0.188	0.131	0.507	0.036	0.410

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates for β_1 and β_2 of equation (1), estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that test for the equality of coefficients of females and males. The dependent variables in columns 1–3, 9 and 10 are observed once for each individual by age 26. Controls include both parents' years of schooling, number of siblings, mother's age at birth and parents' age gap. The dependent variables in columns 4–8 are observed three times for each individual: at age 23, 24 and 25. Controls include both parents' years of schooling, mother's age at birth, parents' age gap, number of siblings and dummies for age. The sample comprises 557 individuals (271 females and 286 males) born between May 27, 1991, and February 15, 1992. In column 8 the sample includes only individuals with positive earnings. The baseline category is arrival in Israel in the third trimester of pregnancy.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Online Appendix

A. Environmental Conditions of Operation Solomon Immigrants in Ethiopia and in Israel

We summarize here the main differences in environmental conditions experienced by mothers in our sample in Ethiopia and in Israel based on interviews, reports in the contemporary media, and other relevant literature.

Living conditions. Prior to Operation Solomon, the Ethiopian Jews lived in hundreds of small remote villages in northern Ethiopia. Their lifestyle, beliefs and occupations were typical of a traditional society. Less than 30% of the population was literate in their native tongue, and schools were not accessible to the majority of the population. In May 1990, a large part of this population migrated to Addis Ababa, where they were housed in refugee camps scattered around the city, in living conditions not better than in the rural areas they came from. After their arrival in Israel, most of the immigrants (80%) were housed for the first few years in absorption centers, and the remainder in mobile home camps (Gould et al., 2004).

General medical care. In rural villages, local traditional practitioners provided most medical care, utilizing traditional medications and treatments. Standard Western perceptions of disease causation were uncommon. For many, their first exposure to Western medical practices was through medical clinics established by the American Jewish Joint Distribution Committee (AJDC) in Addis Ababa, where the immigrants were housed before their evacuation to Israel. These clinics were established in August 1990 following an increase in the incidence of malaria, hepatitis and tuberculosis after the refugees' arrival in Addis Ababa. The AJDC developed a comprehensive medical program that included immunization and training of Ethiopian health practitioners by Israeli doctors, and that served approximately 4,000 families. These health services significantly reduced the death rate in the following months (Myers, 1993).

Following their arrival in Israel, the immigrants were registered in family groups according to date of arrival, age and sex. The immigrants' weight and height were recorded, and physical examinations were carried out by medical teams.[35] Blood samples were obtained for complete blood count, VDRL, HBsAg, GCPD and SMA-12. Urinalysis and thick film examination for malaria and borreliosis were also performed, along with chest X-rays and tuberculin tests (Nahmias et al., 1993).

Most of the absorption centers had access to a primary care clinic on location or nearby. These provided medical services to the immigrants. All clinics were staffed by a physician, a nurse, and an interpreter/mediator (Flatau et al., 1993; Sgan-Cohen et al., 1993; Shtarkshall et al., 2009;

[35]Unfortunately, these data are not available.

Levin-Zamir et al., 1993). They provided care for acute and chronic illness and preventive care, along with mother and child health care and immunizations (Yaphe et al., 2001). The Israeli health authorities developed an educational program to bridge the cultural gaps between immigrants and health care practitioners, and to promote the transfer of skills to the immigrants regarding proper health care, nutrition, prescribed medications, and personal hygiene (Levin-Zamir et al., 1993).

Nutrition. The International Food Policy Research Institute (IFPRI) reports that in 1993 the calorie supply per capita in Ethiopia was 1,516, while in Israel it was twice as large, 3,089 (Israeli CBS, 2008). The traditional Ethiopian diet consisted of unrefined flours, grains, vegetables, refined sugars, and processed foods, and was limited in meat. These eating habits changed upon arrival in Israel, as many of the traditional Ethiopian staples were not available at the time in Israel (Levin-Zamir et al., 1993).

Micronutrient supplements for pregnant women. Three main micronutrient supplements are important for cognition and recommended for pregnant women: iron, iodine and folic acid.[36] The 2011 Ethiopian Demographic and Health Survey reports that 83% of women did not take iron tablets during their last pregnancy, and less than 1% took them for 90 days or more during their last pregnancy.[37] Furthermore, a situational analysis carried out by the Ministry of Health (MOH) and the United Nations Children's Fund (UNICEF) in Ethiopia in 1993 reports that 78% of the population are exposed to iodine deficiency and 62% are iodine-deficient (Taye and Argaw, 1997). In a 2004 WHO report, Ethiopia was categorized among moderately iodine-deficient countries, with only 20% of households having access to adequately iodized salt.[38]

In Israel, in contrast, it was a standard practice at the time to prescribe vitamin and iron supplements to pregnant women. Ethiopian women who arrived in Operation Solomon agreed to take these supplements even though many believed that in Ethiopia this was not needed because "the food was better, it contains more vitamins than the food in Israel" (Granot et al., 1996). No iodine deficiency disorders are found among pregnant women in Israel, largely because Israel's food chain contains adequate amounts of iodine (Benbassat et al., 2004).

Antenatal care and monitoring. Ethiopian women who lived in rural areas shared the view that pregnancy does not require medical attention. They gave birth at home with assistance from family and neighbors, and a traditional birth attendant or lay midwife. In contrast, in Israel, pregnancies among Ethiopians were closely monitored, the baby and mother were examined periodically before and after birth, and almost all births were in hospitals. In 1990-1991, the infant mortality rate was 12% in Ethiopia and 1% in Israel, and the child mortality rate was 20% in Ethiopia but only 1.2% in Israel (The World Bank, 1991). All the women we surveyed attested that in Ethiopia they

[36] In Appendix B we provide additional information on the importance of micronutrients for development.

[37] Ethiopia Demographic and Health Survey 2011, p. 187.

[38] Ethiopia Demographic and Health Survey 2005, p. 151.

had received no pregnancy-related medical care, while in Israel their pregnancies were medically monitored, with blood tests, ultrasound, and vitamin supplement prescriptions (mainly iron and folic acid).

B. Micronutrient Deficiencies During Pregnancy

Vitamins and minerals, referred to collectively as micronutrients, have important influences on the health of pregnant women and the growing fetus. A recent joint statement by the World Health Organization (WHO), the World Food Program, and the United Nations Children's Fund (2007) estimates that more than two billion people in the world are deficient in key vitamins and minerals, particularly vitamin A, iodine, iron and zinc. Most of these people live in low-income countries and are typically deficient in more than one micronutrient. Iron, iodine and folic acid are among the most important micronutrients for in-utero cognition and brain development. A 2008 WHO report on the worldwide prevalence of anemia in 1993–2005 estimates that Africa contains the highest proportion of individuals affected by anemia. In Ethiopia, anemia is a severe problem affecting both pregnant (62.7%) and non-pregnant women of childbearing age (52.3%). According to the WHO report, more than half of this anemia burden is due to iron deficiency (ID), with the rest partly due to deficiency of folic acid, vitamin B12, and vitamin A, along with parasitic infections.

Many important developmental processes, including myelination, dendritogenesis, synaptogenesis, and neurotransmission, are highly dependent on iron-containing enzymes and hemoproteins (Lozoff, 2007). ID disrupts these processes in a regionally specific manner, depending on which brain areas are most rapidly developing at the time of the deficiency (Kretchmer et al., 1996). Longitudinal studies in humans have concluded that fetal or neonatal iron deficiency anemia is associated with diminished general autonomic response, motor maturity and self-regulation (Hernández-Martínez et al., 2011), higher levels of negative emotionality and lower levels of alertness and suitability in infants (Wachs et al., 2005), slower neuronal conduction (Amin et al., 2010), worse learning ability and memory at 3 to 4 years, and poorer performance (Riggins et al., 2009). The irreversibility of maternal iron deficiency was demonstrated by reports on cognitive and behavioral alterations that persisted into childhood and adolescence despite iron treatment in infancy (Grantham-McGregor and Ani, 2001; Lozoff et al., 2000).

Researchers have hypothesized that there exists a "window of vulnerability" to the harmful effects of iron deficiency. In an animal study, Mihaila et al. (2011) demonstrated that maternal exposure to an iron-deficient diet either prior to conception, at the start of the first trimester, or at the onset of the second trimester had a significant negative impact on the offspring's nervous system, placing the window of vulnerability for the fetus in the first two trimesters of gestation.

An additional critical micronutrient deficiency in developing countries is iodine deficiency.The

2004 WHO report mentioned above estimates that almost two billion people (260 million of them in Africa) are at risk of iodine deficiency. Iodine deficiency is now recognized by the WHO as the most common preventable cause of brain damage in the world today (Preedy et al., 2009). Populations who live in areas with low iodine content in the soil and water are at highest risk for iodine deficiency. Dairy foods and certain fruits and vegetables can be rich in iodine, but only if they originate from iodine-rich areas where the nutrient can be absorbed into foods (Ahmed et al., 2012).

Humans require iodine for the biosynthesis of thyroid hormones, especially thyroxine. These hormones affect development of the central nervous system, which is required for intellectual functioning, and regulate many other physiological processes. In utero, development of the central nervous system depends critically on an adequate supply of these hormones, which influence the density of neural networks established in the developing brain (Lamberg, 1991). Up to mid-gestation, the mother is the only source of iodine for the developing brain of the fetus. An inadequate supply of iodine during gestation, if not corrected by timely intervention to reverse the accompanying maternal hypothyroxinemia, results in damage to the fetal brain that is irreversible by mid-gestation. Even mild to moderate maternal hypothyroxinemia may result in suboptimal neurodevelopment (De Escobar et al., 2007).

Indeed, a longitudinal study in China showed that iodine supplementation in the first and second trimesters of pregnancy decreased the prevalence of moderate and severe neurological abnormalities and increased developmental test scores through age 7, compared with supplementation later in pregnancy or treatment after birth (Cao et al., 1994). Results from a long-term follow-up of this intervention suggest that iodine supplementation before the third trimester predicted higher psychomotor test scores for children relative to those who were provided with iodine later in pregnancy or at 2 years of age (O'Donnell et al., 2002). Other studies similarly found that iodine treatment late in pregnancy or afterwards had no benefits on children's IQ at up to 5 years of age, but treatment early in pregnancy or prior to conception improved IQ (see review by Bougma et al., 2013). Overall, the consensus in the literature is that cognition is sensitive to iodine deficiency exclusively during early fetal life (prior to mid-gestation), while growth and psychomotor development are believed to be most affected by deficiency in infancy (Cao et al., 1994; Isa et al., 2000).

Folic acid deficiency in pregnant women is a major public health problem in developing countries. Adequate folic acid (folate) is critical to embryonic and fetal growth at developmental stages characterized by accelerated cell division. It plays an important part in the development of the central nervous system (the spinal cord and brain). In particular, folate is needed for closure of the neural tube—the embryonic precurser to the brain and spinal cord—early in pregnancy (Czeizel and Dudás, 1992; Czeizel et al., 2004). Folic acid deficiency in early pregnancy dramatically increases the risk of neural tube defects and problems with brain development. Therefore, folic acid supplementation is advised for at least the first 12 weeks of pregnancy for all women, even if they are healthy and have a good diet. Folic acid supplementation that begins after the first trimester of pregnancy will not help to prevent these poor birth outcomes. Several human studies have also demonstrated improved cognitive performance in children following maternal folic acid supplement use during the first trimester of pregnancy (Villamor et al., 2012; Chatzi et al., 2012; Roth et al., 2011; Julvez et al., 2009).

C. Data

The NII data source includes:

1. Population Registry data containing the birth date, date of immigration, and country of origin for the individuals in our baseline sample and their parents, as well as information on parents' marital status, number of children and their birth dates.

2. NII records of tertiary education enrollment from 2008 through 2018, based on annual reports submitted to the NII every autumn term by all of Israel's tertiary education institutions.[39] Based on these year-to-year records we define two outcome variables: ever enrolled in post-secondary education up to age 26, and ever enrolled in university or college up to age 26.

3. Israel Tax Authority (ITA) information on income and earnings of employees and self-employed individuals for each year during 2008–2017. Only individuals with non-zero self-employment income are required to file tax returns in Israel, but the ITA has information on annual gross earnings from salaried and non-salaried employment and the number of months employed for all employees through the employer reporting system. This information is transferred annually to the NII, which produces an annual series of total earnings from salaried work and self-employment. Following NII practice, individuals with a positive (non-zero) number of months of work and zero or missing values for earnings are assigned zero earnings. To account for outliers, we winsorize the top and bottom 5th percentile of earnings. We focus on labor market outcomes at ages 23–25 by pooling individuals' annual records.

4. NII records on unemployment and welfare benefits for 2008–2018. This is a panel dataset that contains monthly information on unemployment and welfare transfers.

[39]Israel has seven universities (one of which confers only Master's and PhD degrees), and more than 50 academic colleges that confer undergraduate degrees (some of these also award Master's degrees). The universities require a matriculation diploma and a psychometric exam for enrollment. Most academic colleges also require a matriculation diploma, although some accept specific matriculation diploma components without requiring full certification.

The NII linked the administrative datasets mentioned above to data on students' national standardized tests and questionnaires administered by the Ministry of Education. These data are based on the 2002–2005 GEMS (Growth and Effectiveness Measures for Schools) standardized national tests. Annually since 2002, a representative sample of elementary and middle schools in Israel participate in standardized national tests and complete questionnaires on behavioral outcomes and the school environment. The GEMS student data includes test scores of fifth- and eighth-graders in math, science, Hebrew, and English, and responses of fifth- through ninth-grade students to questionnaires. In the GEMS data sets for 2002–2005 we found 470 of our sample of 570 children who were in utero during Operation Solomon. In the GEMS test scores data, we have 260 fifth-graders and 111 eighth-graders, and in the GEMS questionnaires data, we have 234 fifth-graders, 209 sixth-graders, 201 seventh-graders and 95 eighth-graders.[40] To estimate the treatment effect on test scores and behavioral outcomes, we use only test scores of fifth-graders and questionnaires of fifth- to seventh-graders, as there is pronounced selection in the eighth-grade data.[41]

D. Early Life Health Outcomes

i. Birth Weight Outcomes

Online Appendix Table A2 present estimates of the treatment effect on birth weight (measured in grams) for the baseline OLS specification (equation 1) and a version of the DID specification (equation 2) that includes only the samples born in Israel between May 27, 1991, and February 15, 1992, including the comparison group of children of Ethiopian origin whose parents immigrated before 1989 (comparison group A).[42] The model for this extended sample also controls for month of birth fixed effects, and includes an indicator for comparison group A. In addition, columns 3 and 4 in the table show estimates for the probability of low birth weight (less than 2500 grams). The structure of the table is the same as that of Table 5.[43]

The results reported in columns 1–4 in Online Appendix Table A2 suggest that the large effect of early exposure to better prenatal conditions on human capital outcomes among females is

[40]Some students in our sample took the GEMS tests and questionnaires more than once in different grades.

[41]Children whose mothers arrived in Israel during the third trimester are older. Hence, their likelihood of appearing in the GEMS tests and questionnaires in eighth grade during the years 2002–2005 is significantly higher. In contrast, we do not observe significant differences by trimester group for the probability of appearing in the GEMS tests and questionnaires in the fifth, sixth or seventh grade during the same period. Hence, we limit the test score sample to include only fifth-graders, and the student questionnaire data to include fifth- through seventh-graders, with some of the students appearing in the data more than once.

[42]We include only groups born in Israel because there are no administrative records on the birth weights of children born in Ethiopia.

[43]The sample size is smaller since there are a few observations with missing values for birth weight. We found no correlation between missing birth weight values and the three trimester-group indicators, suggesting that these missing observations are unlikely to affect our results. Moreover, replicating Table 5 with a sample excluding these missing observations generates similar results (results available upon request).

unlikely to be derived from improved birth weight. These results also reduce concerns that our estimated effects on schooling and early adulthood outcomes are due to positive selection of births from arrivals in the first trimester (on the grounds that if selection is driving our results, we should see this also in terms of an effect on birth weight).

A possible explanation for the lack of an effect on birth weight is that intake of micronutrient supplements affected brain development only among children whose mothers arrived during the first trimester, while all other improved environmental conditions had a positive effect on growth even if exposure first occurred during the second or third trimester. This interpretation is supported by evidence documented in Akter et al. (2012) that nutrition counseling among poor urban women in Bangladesh during the third trimester of pregnancy reduces the probability of low birth weight.

Another possible reason for the non-significant results on birth weight could be lack of power, since our sample is relatively small. Previous studies that found effects on birth weight (e.g., Almond and Mazumder, 2011, Black et al., 2016 and Persson and Rossin-Slater, 2018) report an increase in the range of 10–30 grams. To detect such an effect (given the standard deviation of birth weight), we would need a sample of more than 6,600 children. In fact, the effect examined in our study might be larger than in the cited studies, since exposure to better conditions lasted for a longer period and included a broader set of inputs. Our point estimates reported in Online Appendix Table A2 are in the range of 40–90 grams (though they are not significant). To detect an effect of 90 grams we would need a sample of over 734 children. This is closer, but still above our sample size (especially since we mainly contrast only the first- and third-trimester groups). Indeed, we do find some evidence for a positive effect on birth weight for both genders when we use weeks of gestation upon arrival in Israel instead of the trimester indicators (see Online Table A5).

ii. Mortality

The administrative data collected by the Israel CBS do not include information on date of death. Hence, we define a proxy measurement for mortality before age 6 if the child is not observed in the administrative records of the Israel Ministry of Education starting in first grade (given that the Ministry of Education maintains complete records of all Israeli children throughout their education).[44] Overall, given the small sample size, we observe few mortality cases: two children from the first-trimester group, two from the second, and four from the third died before reaching first grade.[45]

Columns 5 and 6 in Online Appendix Table A2 report differences in mortality rates by trimester

[44] We have accurate death records in the NII data, but we prefer to do the analysis using this proxy since the CBS data allow us to include the comparison groups and to control for seasonality and cohort effects. In any case, the results obtained using the two alternative data sources are equivalent.

[45] The mortality records from the NII report nine deaths before age 6 instead of eight.

group for the baseline OLS specification and a DID specification that includes only the samples born in Israel between May 27, 1991, and February 15, 1992. The results suggest that males who arrived in Israel in utero during the first or second trimester were less likely to die relative to those who arrived during the last trimester. A reduction in mortality without an effect on birth weight is consistent with evidence from other studies (e.g., Almond et al., 2005). We caution, however, that the difference in results by gender is driven by only two observations: the same number of males and females died in the first- and second-trimester groups, but in the third-trimester group, three males died versus one female.

Table A1. Estimated Effect of Prenatal Environment on Schooling Outcomes: "Pure" DID Specification

	No Grade Repetition (6th–12th Grade)	Completed 12th Grade	Obtained a Matriculation Diploma	Total Matriculation Units	Math Matriculation Units	English Matriculation Units
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Females						
1st-trimester	0.168***	0.074*	0.169**	4.844***	0.646***	0.824***
	(0.044)	(0.040)	(0.081)	(1.353)	(0.216)	(0.237)
2nd-trimester	0.093**	0.029	0.098	3.163**	0.337	0.619***
	(0.045)	(0.041)	(0.082)	(1.440)	(0.221)	(0.220)
P-value: 1st = 2nd	0.038	0.226	0.344	0.219	0.102	0.369
Panel B. Males						
1st-trimester	0.018	0.001	0.030	1.059	0.114	0.162
	(0.069)	(0.061)	(0.054)	(1.280)	(0.189)	(0.241)
2nd-trimester	-0.029	-0.021	0.001	0.323	0.128	-0.026
	(0.059)	(0.050)	(0.051)	(1.169)	(0.172)	(0.211)
P-value: 1st = 2nd	0.452	0.688	0.563	0.467	0.936	0.337
Panel C. P-value for equality of the coefficient between females and males						
1st-trimester	0.109	0.327	0.124	0.008	0.042	0.024
2nd-trimester	0.121	0.361	0.259	0.055	0.374	0.014

Notes: Standard errors reported in parentheses are clustered at week and year of birth. The table reports estimates for the Operation Solomon sample who immigrated during the first trimester, or $\alpha_1+\alpha_3+\alpha_5+\alpha_7$ from equation (3), and during the second trimester, or $\alpha_2+\alpha_4+\alpha_6+\alpha_8$ from equation (3). The estimates were computed for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel and birth order. The sample includes 2,365 individuals (1,146 females and 1,210 males) born between May 27, 1991, and February 15, 1992, and between May 27, 1990, and February 15, 1991.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table A2. Estimated Effect of Prenatal Environment on Birth Weight and Child Mortality

	Birth Weight (gr)		Low Birth Weight ($<$2500 gr)		Child Mortality (by age 6)	
	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Females						
1st-trimester	92.99	77.60	0.050	0.082	-0.011	0.003
	(70.94)	(96.96)	(0.043)	(0.056)	(0.014)	(0.015)
2nd-trimester	30.46	-120.2	0.036	0.056	-0.007	0.006
	(59.71)	(89.30)	(0.040)	(0.047)	(0.013)	(0.018)
P-value: 1st = 2nd	0.277	0.039	0.655	0.566	0.735	0.805
3rd-trimester Mean and SD	2,997 [438.7]		0.076 [0.267]		0.012 [0.111]	
Panel B. Males						
1st-trimester	91.18	40.78	-0.026	-0.007	-0.031	-0.055**
	(73.56)	(114.9)	(0.038)	(0.056)	(0.020)	(0.026)
2nd-trimester	172.1**	192.9**	-0.046	-0.076	-0.018	-0.025
	(74.47)	(82.74)	(0.038)	(0.050)	(0.017)	(0.019)
P-value: 1st = 2nd	0.093	0.200	0.415	0.157	0.396	0.146
3rd-trimester Mean and SD	3,054 [449.0]		0.106 [0.310]		0.032 [0.176]	
Panel C. P-value for equality of the coefficient between females and males						
1st-trimester	0.986	0.832	0.238	0.290	0.291	0.039
2nd-trimester	0.094	0.008	0.176	0.095	0.544	0.160

Notes: Standard errors reported in parentheses are clustered at week of pregnancy for the OLS regressions and at week and year of birth for the DID regressions. Odd columns report estimates for β_1 and β_2 of equation (1) and even columns report estimates for β_1 and β_2 of equation (2). Both were estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel and birth order. The two-cohorts sample (reported in columns 2, 4 and 6) also includes an indicator for the comparison group and month of birth fixed effects. The baseline sample comprises 570 individuals (277 females and 293 males) born between May 27, 1991, and February 15, 1992, and the two-cohorts sample includes 1,021 individuals (504 females and 517 males) of Ethiopian origin born in Israel during the same period whose parents immigrated before 1989. Birth weight is missing for two females and six males in the baseline sample and for four females and eight males in the two-cohorts sample. The baseline category is immigration in the third trimester of pregnancy.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3. Estimated Effect of Prenatal Environment Excluding Individuals Who Died Before Age 6, Baseline Sample (OLS)

	Females		Males	
	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester
	(1)	(2)	(3)	(4)
Panel A. High School Outcomes				
No grade repetition (6th–12th grade)	0.157***	0.099**	0.006	-0.037
	(0.046)	(0.045)	(0.065)	(0.061)
Completed 12th grade	0.065	0.034	-0.019	-0.035
	(0.041)	(0.041)	(0.056)	(0.048)
Obtained a matriculation diploma	0.150*	0.102	0.046	0.007
	(0.090)	(0.093)	(0.050)	(0.050)
Total matriculation units	4.495***	3.419**	1.061	0.292
	(1.690)	(1.521)	(1.212)	(1.194)
Math matriculation units	0.599**	0.365	0.129	0.147
	(0.246)	(0.231)	(0.200)	(0.209)
English matriculation units	0.730***	0.643***	0.137	-0.051
	(0.280)	(0.222)	(0.202)	(0.155)
Panel B. Early Life Health Outcomes				
Birth weight (*gr*)	58.41	5.725	81.97	165.5**
	(59.19)	(51.79)	(74.22)	(73.92)
Low birth weight (<2500 *gr*)	0.069**	0.043	-0.030	-0.049
	(0.035)	(0.033)	(0.039)	(0.039)
Panel C. Long Term Outcomes				
Any post-secondary enrollment	0.118*	0.076	0.030	0.092*
	(0.062)	(0.058)	(0.039)	(0.054)
University and collage enrollment	0.103*	0.113**	0.006	0.067*
	(0.054)	(0.054)	(0.034)	(0.040)
Welfare recipiency	0.018	-0.003	0.036	0.042
	(0.046)	(0.052)	(0.032)	(0.032)
Employed	0.085***	0.052	-0.033	-0.030
	(0.031)	(0.032)	(0.039)	(0.036)
Employed or studying	0.068**	0.041	-0.033	-0.017
	(0.026)	(0.029)	(0.039)	(0.031)
Annual months worked	1.452***	0.549	-0.743	-0.614
	(0.442)	(0.467)	(0.518)	(0.506)
Monthly earnings (NIS)	388.7*	178.1	-61.49	-483.9*
	(218.9)	(206.8)	(300.4)	(276.2)
Monthly earnings conditional on	-46.18	-69.91	176.1	-296.3
employment (NIS)	(243.2)	(242.9)	(244.4)	(216.3)
Married	-0.028	-0.031	0.023	0.065***
	(0.053)	(0.042)	(0.022)	(0.025)
Children	-0.073	-0.021	0.021	0.032
	(0.064)	(0.055)	(0.027)	(0.032)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. Panel A replicates the results of the odd columns in Table 5 while excluding individuals who died before age 6. The sample includes 562 individuals (274 females and 288 males). Panel B replicates the results of columns 1 and 3 in Table 8 while excluding individuals who died before age 6. The sample includes 548 individuals (267 females and 281 males). Panel C replicates the results in Table 7 while excluding children who died.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4. Estimated Effect of Prenatal Environment on High School Outcomes by Weeks of Exposure to the Israeli Environment

	No Grade Repetition (6th–12th Grade)		Completed 12th Grade		Obtained a Matriculation Diploma		Total Matriculation Units		Math Matriculation Units		English Matriculation Units	
	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Females												
Weeks of exposure	-0.005***	-0.005***	-0.003	-0.003	-0.004	-0.005*	-0.142**	-0.152***	-0.020**	-0.023***	-0.022**	-0.024**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.064)	(0.053)	(0.009)	(0.008)	(0.011)	(0.010)
Panel B. Males												
Weeks of exposure	-0.001	-0.001	-0.0001	-0.001	-0.001	-0.0001	-0.027	-0.014	-0.003	-0.001	-0.004	-0.0031
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.042)	(0.047)	(0.008)	(0.007)	(0.007)	(0.009)
Panel C. P-value for equality of the coefficient between females and males												
Weeks of exposure	0.220	0.197	0.447	0.418	0.419	0.183	0.121	0.026	0.165	0.044	0.161	0.080

Notes: Standard errors reported in parentheses are clustered at week of pregnancy for the OLS regressions and at week and year of birth for the DID regressions. Odd columns report estimates of equation (1) with gestational age (in weeks) at time of immigration as the main explanatory variable instead of the trimester indicators, and even columns report estimates of equation (2) with gestational age (in weeks) at time of immigration as the main explanatory variable. Both were estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel and birth order. The two-cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) also controls for cohort, dummies for the comparison groups, indicator for born in Ethiopia, and month of birth fixed effects. The baseline sample includes 570 individuals (277 females and 293 males) born between May 27, 1991, and February 15, 1992, and the two-cohorts sample includes 2,365 individuals (1,146 females and 1,210 males) born between May 27, 1991, and February 15, 1992, and between May 27, 1990, and February 15, 1991.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5. Estimated Short-, Medium- and Long-Term Effect of Prenatal Environment by Weeks of Exposure to the Israeli Environment

	Early Life Health Outcomes			Test scores and Own Behavior at Elementary and Middle School		Post-Schooling and Welfare Recipiency, Ages 18–26 (1 = Yes, 0 = No)			Labor Market Outcomes Ages 23–25					Marriage and Childbearing by Age 26 (1 = Yes, 0 = No)	
	Birth Weight *gr*	Low Birth Weight $<2500gr$	Child Mortality	GEMS Test Scores	Owen Behavior at School	Any Post-secondary Enroll-ment	University or Collage Enroll-ment	Welfare Recipiency	Emplo-yed	Emplo-yed or Study	Annual Months Worked	Monthly Earnings (NIS)	Monthly Earnings if Worked (NIS)	Married	Children
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Panel A. Females															
Weeks of exposure	-4.633* (2.522)	-0.0013 (0.002)	0.0004 (0.0005)	-0.020*** (0.007)	-0.007** (0.004)	-0.004 (0.002)	-0.003 (0.002)	0.0002 (0.002)	-0.004*** (0.001)	-0.003*** (0.001)	-0.061*** (0.015)	-14.80* (7.755)	3.272 (9.598)	0.001 (0.002)	0.003 (0.003)
Panel B. Males															
Weeks of exposure	-5.598* (3.147)	0.002 (0.002)	0.0012 (0.0008)	0.008 (0.008)	-0.009* (0.005)	0.0008 (0.002)	-0.001 (0.001)	-0.001 (0.002)	0.001 (0.002)	0.0003 (0.002)	0.020 (0.019)	0.274 (9.666)	-5.637 (7.576)	-0.001 (0.001)	-0.001 (0.001)
Panel C. P-value for Difference in the Coefficient between Females and Males															
Weeks of exposure	0.805	0.174	0.300	0.263	0.696	0.475	0.403	0.686	0.045	0.086	0.002	0.233	0.458	0.488	0.164

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates of equation (1) with gestational age (in weeks) at time of immigration as the main explanatory variable instead of the the trimester indicators. Both were estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, mother's age at birth and parents' age gap. Columns 1–3 also include controls for SES of first locality in Israel and birth order. Columns 4–12 include controls for number of siblings. Column 4 includes test year fixed effect and indicators for test subject, and Column 5 includes year and grade dummies. Columns 8–11 also include age dummies. The sample in columns 1 and 2 includes 562 individuals (275 females and 287 males); the sample in column 3 includes 570 individuals (277 females and 293 males); and the sample in columns 4–13 includes 557 individuals (271 females and 286 males). All individuals were born between May 27, 1991, and February 15, 1992.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6. Estimated Effect of Prenatal Environment on High School Outcomes by Gender Among Former Soviet Union Immigrants

	No Grade Repetition (6th–12th Grade)	Completed 12th Grade	Obtained a Matriculation Diploma	Total Matriculation Units	Math Matriculation Units	English Matriculation Units
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Females						
1st-trimester	0.024	-0.004	0.022	-0.177	0.092	-0.027
	(0.030)	(0.020)	(0.035)	(0.806)	(0.133)	(0.133)
2nd-trimester	0.035	-0.003	-0.024	-0.529	0.011	0.051
	(0.030)	(0.020)	(0.035)	(0.808)	(0.134)	(0.133)
P-value: 1st = 2nd	0.721	0.962	0.241	0.692	0.587	0.591
3rd-trimester	0.715	0.92848	0.374	22.23	2.751	3.648
Mean and SD	[0.452]	[0.258]	[0.484]	[10.93]	[1.816]	[1.807]
Panel B. Males						
1st-trimester	-0.015	0.014	0.008	0.679	0.048	0.097
	(0.037)	(0.030)	(0.038)	(0.969)	(0.150)	(0.160)
2nd-trimester	0.053	0.020	0.023	0.943	0.059	0.272*
	(0.033)	(0.028)	(0.036)	(0.940)	(0.145)	(0.158)
P-value: 1st = 2nd	0.078	0.844	0.722	0.802	0.948	0.314
3rd-trimester	0.643	0.837	0.385	18.17	2.348	3.041
Mean and SD	[0.480]	[0.370]	[0.487]	[12.98]	[1.967]	[2.182]

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates for β_1 and β_2 of equation (1), estimated for females and males separately. Panel A reports estimates for females and Panel B reports estimates for males. All specifications control for both parents' years of schooling, number of siblings, year of birth fixed effects and month of birth fixed effects. The baseline sample includes 2039 individuals (915 females and 1128 males) born between 1990 and 1992. The baseline category is immigration in the third trimester of pregnancy.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A7. Estimated Effect of Mothers' Length of Residence in Israel Before the Birth on High School Outcomes and Early Life Health Outcomes

	No Grade Repetition (6th–12th Grade)	Completed 12th Grade	Obtained a Matriculation Diploma	Total Matriculation Units	Math Matriculation Units	English Matriculation Units	Birth Weight	Low Birth Weight	Child Mortality
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Females									
Weeks in Israel	-0.0009	-0.0010**	-0.0002	-0.0212	-0.0020	-0.0011	0.5320	0.0001	-0.0002
	(0.0007)	(0.0006)	(0.0011)	(0.0232)	(0.0030)	(0.0031)	(0.9679)	(0.0006)	(0.0002)
Panel B. Males									
Weeks in Israel	-0.0002	0.0002	0.0004	0.0077	0.0021	-0.0005	-1.2156*	0.0003	-0.0001
	(0.0008)	(0.0007)	(0.0007)	(0.0201)	(0.0024)	(0.0035)	(0.6413)	(0.0003)	(0.0001)

Notes: Standard errors reported in parentheses are clustered at week and year of birth. The table reports estimates of equation (1) with the number of weeks since the mother's immigration to Israel when the child was born (ranging from 43 to 127) as the main explanatory variable instead of the trimester indicators. The equation is estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. All specifications control for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel and birth order. The sample includes 962 individuals (479 females and 483 males) born between March 1992 and October 1994.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A8. Estimated Effect of Prenatal Environment Excluding Low Birth Weight Children, Baseline Sample (OLS)

	Females		Males	
	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester
	(1)	(2)	(3)	(4)
Panel A. High School Outcomes				
No grade repetition (6th–12th grade)	0.153***	0.101**	0.006	-0.031
	(0.050)	(0.047)	(0.068)	(0.059)
Completed 12th grade	0.052	0.023	-0.006	-0.027
	(0.045)	(0.044)	(0.064)	(0.054)
Obtained a matriculation diploma	0.170*	0.101	0.039	-0.002
	(0.090)	(0.098)	(0.056)	(0.053)
Total Matriculation units	4.324***	3.149*	0.435	-0.309
	(1.684)	(1.649)	(1.391)	(1.267)
Math Matriculation units	0.603**	0.334	0.063	0.082
	(0.253)	(0.246)	(0.221)	(0.211)
English Matriculation units	0.727**	0.571**	-0.019	-0.162
	(0.285)	(0.241)	(0.218)	(0.163)
Panel B. Early Life Health Outcomes				
Birth weight (*gr*)	115.8*	70.15	89.90	150.8***
	(59.40)	(47.73)	(60.66)	(58.01)
Child mortality (by age 6)	0.005	-0.003	-0.026	-0.015
	(0.005)	(0.003)	(0.020)	(0.018)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. Panel A replicates the results of the odd columns in Table 5 and Panel B replicates the results of columns 1 and 5 in Table 8, excluding observations with low birth weight (i.e., less than 2500 *gr*) or missing birth weight. The sample includes 520 individuals (250 females and 270 males).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A9. Estimated Effect of Prenatal Environment by Month of Arrival in First Trimester, Baseline Sample (OLS)

	Females				Males			
	1st-month	2nd-month	3rd-month	2nd-trimester	1st-month	2nd-month	3rd-month	2nd-trimester
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. High School Outcomes								
No grade repetition (6th–12th grade)	0.064	0.178***	0.217***	0.102**	0.058	-0.011	0.052	-0.023
	(0.117)	(0.038)	(0.047)	(0.044)	(0.105)	(0.103)	(0.069)	(0.058)
Completed 12th grade	-0.020	0.085***	0.128***	0.038	-0.010	-0.036	0.044	-0.019
	(0.128)	(0.033)	(0.041)	(0.042)	(0.105)	(0.102)	(0.053)	(0.048)
Obtained a matriculation diploma	0.134	0.192**	0.072	0.103	0.162*	0.004	0.068	0.016
	(0.133)	(0.087)	(0.135)	(0.092)	(0.091)	(0.060)	(0.065)	(0.051)
Total matriculation units	3.855	5.525***	3.093	3.455**	1.985	1.048	1.303	0.450
	(3.816)	(1.415)	(2.818)	(1.556)	(2.000)	(1.774)	(1.388)	(1.176)
Math matriculation units	0.514	0.819***	0.235	0.376	0.300	0.005	0.243	0.166
	(0.458)	(0.230)	(0.313)	(0.233)	(0.263)	(0.301)	(0.218)	(0.207)
English matriculation units	0.606	0.914***	0.508*	0.647***	0.389	0.295	0.019	-0.024
	(0.818)	(0.271)	(0.276)	(0.227)	(0.383)	(0.282)	(0.278)	(0.152)
Panel B. Early Life Health Outcomes								
Birth weight (*gr*)	107.5	68.59	129.6	30.71	151.0	92.29	70.82	171.8**
	(81.49)	(82.65)	(105.03)	(59.75)	(177.47)	(73.84)	(78.61)	(74.44)
Low birth weight	0.080	0.052	0.023	0.036	-0.091**	-0.001	-0.027	-0.046
	(0.064)	(0.046)	(0.063)	(0.040)	(0.035)	(0.058)	(0.036)	(0.038)
Child mortality (by age 6)	0.009	-0.002	-0.045*	-0.007	-0.052**	-0.022	-0.031**	-0.019
	(0.026)	(0.010)	(0.023)	(0.013)	(0.025)	(0.029)	(0.015)	(0.017)
Panel C. GEMS Outcomes								
GEMS test scores	0.535**	0.530***	0.898***	0.300**	0.549**	0.434	0.001	-0.089
	(0.250)	(0.198)	(0.303)	(0.143)	(0.240)	(0.311)	(0.240)	(0.204)
Own behavior at school	0.317***	0.229**	0.164	0.000	0.502***	0.318**	0.001	-0.034
	(0.123)	(0.097)	(0.122)	(0.074)	(0.156)	(0.137)	(0.116)	(0.108)
Panel D. Long-Term Human Capital Outcomes								
Any post-secondary Enrollment	0.031	0.118*	0.221***	0.084	0.122**	0.082*	-0.045	0.096*
	(0.162)	(0.069)	(0.082)	(0.057)	(0.054)	(0.046)	(0.033)	(0.054)
University & college enrollment	0.039	0.085	0.206*	0.118**	0.089	0.028	-0.038	0.070*
	(0.119)	(0.059)	(0.107)	(0.053)	(0.068)	(0.039)	(0.032)	(0.040)
Welfare recipiency	0.104	0.032	-0.066	-0.001	-0.001	0.078**	0.014	0.043
	(0.083)	(0.054)	(0.055)	(0.051)	(0.050)	(0.036)	(0.035)	(0.032)
Employed	0.065	0.113***	0.062	0.061*	0.040	0.000	-0.038	-0.000
	(0.063)	(0.029)	(0.050)	(0.034)	(0.036)	(0.070)	(0.030)	(0.035)
Employed or studying	0.035	0.105***	0.038	0.050	0.043	-0.002	-0.038	0.013
	(0.057)	(0.024)	(0.047)	(0.031)	(0.038)	(0.070)	(0.031)	(0.031)
Annual months worked	1.298**	1.708***	1.097	0.620	-0.612	0.011	-0.964*	-0.309
	(0.599)	(0.419)	(0.688)	(0.488)	(0.831)	(0.628)	(0.501)	(0.481)
Monthly earnings (NIS)	471.8	546.2**	221.3	236.1	250.3	218.2	-170.9	-324.8
	(340.8)	(225.8)	(369.8)	(216.7)	(307.3)	(328.7)	(296.0)	(259.4)
Monthly earnings conditional	116.0	12.9	-127.3	-49.80	240.0	349.0	-8.550	-294.6
on employment (NIS)	(398.8)	(257.7)	(343.8)	(216.4)	(258.6)	(258.2)	(354.8)	(216.4)
Panel E. Marriage and Childbearing by Age 26								
Married	-0.038	-0.098**	0.135*	-0.024	-0.021	0.050	0.013	0.065***
	(0.103)	(0.043)	(0.078)	(0.042)	(0.016)	(0.035)	(0.027)	(0.024)
Children	-0.016	-0.117**	-0.014	-0.015	0.030	0.025	0.014	0.032
	(0.145)	(0.055)	(0.073)	(0.053)	(0.053)	(0.037)	(0.034)	(0.031)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates of equation (1) while stratifying the first trimester into three variables: 1st month is an indicator for immigrating to Israel during weeks 2–4 of gestation, 2nd month is an indicator for immigrating to Israel during weeks 5–8 of gestation, and 3rd month is an indicator for immigrating to Israel during weeks 9–12 of gestation. Panel A replicates the results of the odd columns in Table 5, while Panel B replicates the results of the odd columns in Table 8. Panel C replicates the results of Table 6, and Panels D and E replicate the results of Table 7.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A10. Estimated Effect of Prenatal Environment for Females, Excluding the First Two Weeks of Each Trimester Group, Baseline Sample (OLS)

	Excluding the First Two Weeks of 1st Trimester		Excluding the First Two Weeks of 2nd Trimester		Excluding the First Two Weeks of 3rd Trimester		Excluding First Two Weeks of All Trimesters	
	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. High School Outcomes								
No grade repetition (6th–12th grade)	0.181***	0.102**	0.167***	0.116**	0.162***	0.105**	0.180***	0.116**
	(0.040)	(0.045)	(0.046)	(0.047)	(0.048)	(0.049)	(0.043)	(0.051)
Completed 12th grade	0.091***	0.038	0.074*	0.046	0.101**	0.067	0.119***	0.073
	(0.033)	(0.042)	(0.043)	(0.042)	(0.045)	(0.045)	(0.038)	(0.045)
Obtained a matriculation diploma	0.134	0.103	0.140	0.111	0.188*	0.152	0.159	0.153
	(0.089)	(0.093)	(0.090)	(0.094)	(0.101)	(0.103)	(0.102)	(0.107)
Total matriculation units	4.409***	3.461**	4.428***	3.798**	5.312***	4.451**	4.984***	4.710***
	(1.571)	(1.563)	(1.709)	(1.553)	(1.887)	(1.742)	(1.804)	(1.767)
Math matriculation units	0.604**	0.372	0.581**	0.416*	0.751***	0.549**	0.721***	0.572**
	(0.238)	(0.234)	(0.244)	(0.233)	(0.262)	(0.244)	(0.256)	(0.248)
English matriculation units	0.668***	0.650***	0.731**	0.665***	0.730**	0.675**	0.633**	0.684**
	(0.250)	(0.229)	(0.287)	(0.234)	(0.314)	(0.265)	(0.289)	(0.275)
Panel B. Early Life Health Outcomes								
Birth weight (*gr*)	97.63	30.75	90.45	8.64	109.70	48.32	112.67	26.79
	(76.76)	(59.92)	(71.44)	(59.82)	(79.21)	(66.43)	(85.65)	(67.14)
Low birth weight	0.035	0.036	0.051	0.050	0.032	0.018	0.019	0.034
	(0.045)	(0.041)	(0.044)	(0.041)	(0.047)	(0.043)	(0.050)	(0.045)
Child mortality (by age 6)	-0.008	-0.007	-0.011	-0.006	-0.016	-0.011	-0.014	-0.011
	(0.014)	(0.013)	(0.014)	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)
Panel C. GEMS Outcomes								
GEMS test scores	0.685***	0.304**	0.599***	0.283**	0.650***	0.333**	0.548***	0.300**
	(0.206)	(0.146)	(0.205)	(0.140)	(0.225)	(0.159)	(0.203)	(0.143)
Own behavior at school	0.228**	0.001	0.212**	0.010	0.312***	0.072	0.248***	0.007
	(0.100)	(0.075)	(0.098)	(0.073)	(0.103)	(0.074)	(0.094)	(0.074)
Panel D. Long-Term Human Capital Outcomes								
Any post-secondary enrollment	0.125**	0.076	0.121*	0.085	0.130**	0.093	0.113	0.077
	(0.062)	(0.057)	(0.064)	(0.064)	(0.063)	(0.058)	(0.069)	(0.057)
University & college enrollment	0.108*	0.110**	0.100*	0.122**	0.100*	0.114*	0.096	0.108**
	(0.059)	(0.053)	(0.056)	(0.059)	(0.060)	(0.059)	(0.060)	(0.053)
Welfare recipiency	-0.012	0.003	0.022	0.007	0.012	-0.007	0.038	-0.002
	(0.043)	(0.052)	(0.045)	(0.055)	(0.048)	(0.054)	(0.048)	(0.052)
Employed	0.080**	0.062*	0.088**	0.066*	0.085**	0.058	0.091**	0.063*
	(0.036)	(0.034)	(0.035)	(0.035)	(0.036)	(0.036)	(0.036)	(0.034)
Employed or studying	0.066**	0.051*	0.071**	0.056*	0.071**	0.050	0.073**	0.052*
	(0.033)	(0.031)	(0.031)	(0.032)	(0.033)	(0.033)	(0.032)	(0.031)
Annual months worked	1.392***	0.616	1.472***	0.654	1.309***	0.494	1.608***	0.647
	(0.464)	(0.484)	(0.473)	(0.522)	(0.428)	(0.467)	(0.467)	(0.490)
Monthly earnings (NIS)	293.4	194.5	422.4*	331.0	370.7*	196.8	520.5**	219.4
	(235.7)	(222.4)	(220.6)	(218.9)	(216.7)	(229.8)	(208.4)	(219.1)
Monthly earnings conditional	-113.80	-92.29	-21.23	27.94	-29.53	-54.82	68.72	-76.87
on employment (NIS)	(256.6)	(246.4)	(243.5)	(240.8)	(287.2)	(290.4)	(234.0)	(242.1)
Panel E. Marriage and Childbearing by Age 26								
Married	-0.028	-0.028	-0.027	-0.052	-0.019	-0.022	-0.063	-0.031
	(0.054)	(0.042)	(0.052)	(0.042)	(0.053)	(0.043)	(0.045)	(0.042)
Children	-0.092	-0.015	-0.074	-0.023	-0.089	-0.037	-0.063	-0.019
	(0.058)	(0.054)	(0.063)	(0.056)	(0.065)	(0.055)	(0.068)	(0.054)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates of equation (1) based on samples that exclude births from the first two weeks of each trimester group separately, and all together. Panel A replicates the results of the odd columns in Panel A of Table 5. Panel B replicates the results of the odd columns in Panel A of Table 8. Panel C replicate the results in Panel A of Table 6, and Panels D and E replicate the results in Panel A of Table 7.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A11. Estimated Effect of Prenatal Environment for Females, Excluding the Last Two Weeks of Each Trimester Group, Baseline Sample (OLS)

	Excluding the Last Two Weeks of 1st Trimester		Excluding the Last Two Weeks of 2nd Trimester		Excluding the Last Two Weeks of 3rd Trimester		Excluding the Last Two Weeks of All Trimester	
	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. High School Outcomes								
No grade repetition (6th–12th grade)	0.157***	0.105**	0.163***	0.108**	0.167***	0.107**	0.158***	0.113**
	(0.047)	(0.045)	(0.046)	(0.043)	(0.046)	(0.046)	(0.048)	(0.044)
Completed 12th grade	0.066	0.041	0.073*	0.049	0.075*	0.040	0.064	0.052
	(0.044)	(0.042)	(0.042)	(0.039)	(0.043)	(0.043)	(0.044)	(0.040)
Obtained a matriculation diploma	0.137	0.109	0.152*	0.101	0.149*	0.106	0.143	0.111
	(0.091)	(0.092)	(0.090)	(0.095)	(0.089)	(0.093)	(0.094)	(0.095)
Total matriculation units	4.247**	3.566**	4.539***	3.612**	4.694***	3.652**	4.434**	3.947**
	(1.778)	(1.547)	(1.700)	(1.574)	(1.696)	(1.568)	(1.807)	(1.575)
Math matriculation units	0.606**	0.394*	0.606**	0.379	0.609**	0.394*	0.624**	0.418*
	(0.253)	(0.231)	(0.250)	(0.239)	(0.246)	(0.234)	(0.260)	(0.237)
English matriculation units	0.742**	0.655***	0.735***	0.662***	0.781***	0.690***	0.777***	0.716***
	(0.297)	(0.227)	(0.283)	(0.230)	(0.284)	(0.229)	(0.301)	(0.236)
Panel B. Early Life Health Outcomes								
Birth weight (*gr*)	73.91	35.67	90.80	60.58	92.94	29.15	68.98	62.90
	(68.00)	(60.08)	(71.68)	(59.48)	(71.37)	(60.01)	(68.61)	(60.76)
Low birth weight	0.048	0.034	0.051	0.018	0.047	0.033	0.047	0.014
	(0.043)	(0.040)	(0.043)	(0.039)	(0.044)	(0.041)	(0.043)	(0.040)
Child mortality (by age 6)	-0.007	-0.009	-0.011	-0.017	-0.011	-0.007	-0.007	-0.018
	(0.013)	(0.013)	(0.014)	(0.011)	(0.014)	(0.013)	(0.014)	(0.011)
Panel C. GEMS Outcomes								
GEMS test scores	0.555***	0.293**	0.622***	0.298**	0.657***	0.321**	0.453**	0.299**
	(0.201)	(0.139)	(0.214)	(0.150)	(0.227)	(0.158)	(0.212)	(0.150)
Own behavior at school	0.213**	-0.020	0.269***	0.044	0.288***	0.072	0.252***	0.017
	(0.097)	(0.071)	(0.098)	(0.072)	(0.107)	(0.074)	(0.096)	(0.071)
Panel D. Long-Term Human Capital Outcomes								
Any post-secondary enrollment	0.119*	0.112*	0.119*	0.082	0.146**	0.096	0.118*	0.113*
	(0.063)	(0.058)	(0.064)	(0.058)	(0.064)	(0.063)	(0.069)	(0.058)
University & college enrollment	0.103*	0.141**	0.106*	0.120**	0.109*	0.120*	0.103*	0.141***
	(0.056)	(0.056)	(0.056)	(0.054)	(0.064)	(0.063)	(0.061)	(0.054)
Welfare recipiency	0.013	-0.029	0.013	-0.007	-0.019	0.005	0.029	-0.035
	(0.045)	(0.045)	(0.046)	(0.052)	(0.046)	(0.057)	(0.049)	(0.045)
Employed	0.093***	0.077**	0.093***	0.067*	0.079**	0.062*	0.097***	0.081**
	(0.034)	(0.033)	(0.035)	(0.035)	(0.040)	(0.037)	(0.036)	(0.034)
Employed or studying	0.076**	0.066**	0.076**	0.056*	0.068*	0.054	0.079**	0.070**
	(0.030)	(0.029)	(0.031)	(0.032)	(0.037)	(0.034)	(0.033)	(0.030)
Annual months worked	1.546***	0.931*	1.545***	0.713	1.289***	0.485	1.705***	0.972**
	(0.460)	(0.486)	(0.472)	(0.502)	(0.477)	(0.501)	(0.475)	(0.494)
Monthly earnings (NIS)	416.8*	316.338	400.5*	217.4	309.5	280.7	523.8**	301.6
	(215.8)	(218.8)	(225.4)	(228.7)	(254.5)	(239.0)	(214.7)	(226.5)
Monthly earnings conditional	-49.76	-39.12	-69.38	-96.42	-61.61	22.47	41.29	-74.15
on employment (NIS)	(242.0)	(244.1)	(250.9)	(251.5)	(309.2)	(295.6)	(239.2)	(251.6)
Panel E. Marriage and Childbearing by Age 26								
Married	-0.029	-0.030	-0.030	-0.034	-0.022	-0.045	-0.070	-0.037
	(0.051)	(0.046)	(0.052)	(0.042)	(0.056)	(0.044)	(0.045)	(0.047)
Children	-0.076	-0.030	-0.076	-0.024	-0.114*	-0.038	-0.071	-0.035
	(0.062)	(0.056)	(0.064)	(0.055)	(0.061)	(0.058)	(0.068)	(0.057)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates of equation (1) based on samples that exclude births from the last two weeks of each trimester group separately, and all together. Panel A replicates the results of the odd columns in Panel A of Table 5. Panel B replicates the results of the odd columns in Panel A of Table 8. Panel C replicates the results in Panel A of Table 6, and Panels D and E replicate the results in Panel A of Table 7.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A12. Estimated Effect of Prenatal Environment for Females, with Trimester Reassignments (Arrival in First or Last Two Weeks of Each Trimester Reassigned to Previous or Next Trimester), Baseline Sample (OLS)

	First Two Weeks Reassigned to Previous Trimester		Last Two Weeks Reassigned to Next Trimester	
	1st-trimester	2nd-trimester	1st-trimester	2nd-trimester
	(1)	(2)	(3)	(4)
Panel A. High School Outcomes				
No grade repetition (6th–12th grade)	0.160***	0.104**	0.100*	0.102**
	(0.047)	(0.049)	(0.053)	(0.043)
Completed 12th grade	0.111***	0.087**	0.025	0.055
	(0.043)	(0.042)	(0.052)	(0.039)
Obtained a matriculation diploma	0.125	0.133	0.155*	0.098
	(0.096)	(0.097)	(0.089)	(0.091)
Total matriculation units	4.044**	4.115**	4.569***	3.618**
	(1.680)	(1.628)	(1.628)	(1.461)
Math matriculation units	0.612**	0.539**	0.631***	0.338
	(0.253)	(0.234)	(0.244)	(0.223)
English matriculation units	0.591**	0.519*	0.740***	0.596***
	(0.252)	(0.266)	(0.261)	(0.216)
Panel B. Early Life Health Outcomes				
Birth weight (*gr*)	125.2	27.67	102.3	102.9*
	(77.96)	(66.85)	(66.48)	(58.34)
Low birth weight	0.000	0.021	0.017	-0.008
	(0.048)	(0.045)	(0.045)	(0.042)
Child mortality (by age 6)	-0.015	-0.013	-0.014	-0.029**
	(0.014)	(0.014)	(0.016)	(0.014)
Panel C. GEMS Outcomes				
GEMS test scores	0.650***	0.306**	0.378*	0.342**
	(0.211)	(0.146)	(0.209)	(0.136)
Own behavior at school	0.228**	0.096	0.219**	-0.005
	(0.103)	(0.073)	(0.088)	(0.068)
Panel D. Long-Term Human Capital Outcomes				
Any post-secondary enrollment	0.088	0.067	0.201***	0.140**
	(0.055)	(0.060)	(0.072)	(0.055)
University & college enrollment	0.078	0.103*	0.161***	0.153***
	(0.053)	(0.056)	(0.058)	(0.050)
Welfare recipiency	-0.023	0.004	0.006	-0.066
	(0.046)	(0.054)	(0.055)	(0.052)
Employed	0.052	0.035	0.083**	0.082**
	(0.035)	(0.034)	(0.033)	(0.032)
Employed or studying	0.044	0.034	0.072**	0.073**
	(0.033)	(0.031)	(0.030)	(0.029)
Annual months worked	1.131***	0.343	1.239**	1.114**
	(0.391)	(0.469)	(0.554)	(0.445)
Monthly earnings (NIS)	195.7	273.1	423.3*	311.3
	(262.8)	(234.5)	(236.3)	(204.3)
Monthly earnings conditional	-59.70	141.5	-6.500	-67.50
on employment (NIS)	(304.1)	(281.4)	(240.0)	(234.2)
Panel E. Marriage and Childbearing by Age 26				
Married	0.012	-0.020	-0.006	-0.009
	(0.051)	(0.040)	(0.055)	(0.043)
Children	-0.116**	-0.063	-0.018	-0.046
	(0.056)	(0.060)	(0.064)	(0.051)

Notes: Standard errors reported in parentheses are clustered at week of pregnancy. The table reports estimates of equation (1) based on a sample where births from the first (last) two weeks of each trimester group are reassigned to the previous (next) trimester. Panel A replicates the results of the odd columns in Panel A of Table 5. Panel B replicates the results of the odd columns in Panel A of Table 8. Panel C replicates the results in Panel A of Table 6, and Panels D and E replicate the results in Panel A of Table 7.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A13. Evidence for Equal Distribution of Miscarriages across Trimester Groups

	Mother's Age at Birth for First-Born Children		Number of Months between Child's Birth and the Previous Child (Parities higher than one)	
	Baseline Sample (OLS)	Two Cohorts Sample (DID)	Baseline Sample (OLS)	Two Cohorts Sample (DID)
	(1)	(2)	(3)	(4)
Panel A. Females				
1st-trimester	-1.522	-2.152**	-4.014	-5.050
	(1.244)	(1.083)	(3.510)	(3.676)
2nd-trimester	-0.099	-0.395	3.064	2.718
	(1.197)	(0.972)	(3.276)	(3.765)
P-value: 1st = 2nd	0.070	0.063	0.003	0.000
3rd-trimester Mean and SD	21.47 [3.793]		36.64 [19.68]	
Panel B. Males				
1st-trimester	1.193	0.929	-7.234***	-6.790***
	(1.019)	(1.014)	(2.594)	(2.310)
2nd-trimester	2.370*	2.394*	-2.797	-2.090
	(1.221)	(1.284)	(2.720)	(2.830)
P-value: 1st = 2nd	0.327	0.222	0.101	0.098
3rd-trimester Mean and SD	19.65 [3.048]		36.37 [17.27]	
Panel C. P-value for equality of the the coefficient between females and males				
1st-trimester	0.016	0.011	0.401	0.627
2nd-trimester	0.089	0.075	0.117	0.217

Notes: Standard errors reported in parentheses are clustered at week of pregnancy for the OLS regressions, and at week and year of birth for the DID regressions. Columns 1 and 2 report estimates from regression of mother's age at birth for first-born children on an indicator for the first-trimester and second-trimester groups. Columns 3 and 4 report estimates from regression of the number of months between the child's birth and that of the previous child for children born at higher parities on an indicator for the first- and second-trimester groups. Odd columns include only individuals from the baseline sample (Operation Solomon), and even columns include individuals both from the baseline sample (Operation Solomon) and the comparison groups. All regressions were estimated for females and males separately as a system of seemingly unrelated regressions. Panel A reports estimates for females and Panel B reports estimates for males. Panel C reports p-values from F-tests that check the difference between coefficients of females and males. All specifications control for both parents' years of schooling, parents' age gap, SES of first locality in Israel and birth order. The two-cohorts sample (reported in the even columns) also controls for cohort, dummies for the comparison groups, indicator for born in Ethiopia, and month of birth fixed effects. The baseline sample in column 1 includes 125 firstborn individuals (60 females and 65 males), and that in column 2 includes 445 higher-parity children (217 females and 228 males). All individuals in columns 1 and 3 were born between May 27, 1991, and February 15, 1992. The two-cohorts sample in column 2 includes 452 firstborn individuals (219 females and 233 males), and in column 4 it includes 1,913 higher-parity individuals (936 females and 977 males). All children were born between May 27, 1991, and February 15, 1992, or between May 27, 1990, and February 15, 1991. The baseline category is immigration in the third trimester of pregnancy.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.