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ABSTRACT

This paper investigates the effects of environmental conditions during pregnancy on later life outcomes using quasi-experimental variation created by the immigration of Ethiopian Jews to Israel in May 24th 1991. Children in utero prior to immigration faced dramatic differences in medical care technologies, prenatal conditions, and prenatal care at the move from Ethiopia to Israel. One of the major differences was adequacy of micronutrient supplements, particularly iodine, iron and folic acid. We find that children exposed in an earlier stage of the pregnancy to better environmental conditions in utero have two decades later higher educational attainment (lower repetition and dropout rates and higher Baccalaureate rate) and higher education quality (achieve a higher proficiency level in their Baccalaureate diploma). The average treatment effect we estimate is driven mainly by a strong effect on girls. We find however, no effect on birth weight or mortality for girls.

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1. Introduction

There is growing epidemiological and economic literature that suggests that certain chronic conditions later in life can be traced to the course of fetal development.[1] The idea that the nine months in utero are a critical period in a person's life which influences health, cognitive and non-cognitive, and economic outcomes later in life has meaningful implications for individual and policy decisions. However, it is a challenge to identify the casual effect of in utero conditions on later life outcomes since children's family background is most likely correlated with in-utero conditions. But it may also have direct effects on human capital investments and outcomes. Economists have expanded the epidemiological literature on this hypothesis by analyzing the effect of in utero conditions on non-health outcomes such as education and income while improving the identification strategies (see reviews by Almond and Currie, 2011 and Currie and Vogl, 2013).

In this paper, we use a permanent out of Africa episode where the Jewish population in Ethiopia immigrated to Israel in May 1991. We exploit the quasi-experimental variation in the environmental conditions during pregnancy experienced by women who gave birth shortly after arrival to Israel. There is a large environmental difference between Ethiopia and Israel that may have affected pregnant mothers. One important difference is the micro nutrient supplements. While Ethiopia suffers from severely iodine and iron deficiencies and there is no consumption of vitamins during pregnancy, in Israel, pregnant women received vitamins (mainly iron and folic acid) and the iodine level is adequate.

In our study, we examine the effects of in utero length of exposure to micronutrient supplement of iodine, iron and folic acid and to other improved conditions in Israel on birth outcomes (birth weight), mortality until age 12 and academic achievements of children by the end of high school. We exploit quasi-experimental variation in exposure to better environmental conditions in utero generated by the large and sudden immigration wave of Ethiopian Jews to Israel, called "Operation Solomon". This out of Africa immigration episode was unexpected and occurred quickly over 36 hours when more than 14,000 Jews were airlifted to Israel. The operation was organized by the Israeli government and it relocated almost all the Ethiopians Jews living in Ethiopia to Israel. Thus, the immigrants were not a selected group and the sudden occurrence and timing of this operation did not allow families to plan or time pregnancy. Therefore, variation in the timing of pregnancy relative to date of immigration can be regarded as random.

We construct a dataset based on high school administrative data linked to individual demographic, birth weight and mortality records of all Ethiopian children born between May 27th 1991 and February 15th 1992, within a narrow time window after the immigration (May 24th 1991). We use the birth date of each child to determine number of weeks of exposure in utero to better environmental conditions in Israel. Epidemiological studies suggest that the most critical period of pregnancy for child brain and

[1] Barker (1992) define this relationship as the fetal origin hypothesis.

cognitive development is the first trimester. We therefore examine how in utero exposure to the Israeli environment during the first trimester of gestation (and afterwards) affects birth weight, mortality, and medium-term cognitive outcomes relative to exposure that started at later stages of pregnancy. For this purpose, we define three treatment groups by the gestational age at the time of immigration: the first group includes children whose mothers arrived to Israel after conception during the first trimester of gestation, the second group includes children whose mothers arrived to Israel during the second trimester of gestation, and the third group includes children whose mothers arrived during the third trimester of gestation but before birth. We also estimate separate treatment effects for each of the three months of the first trimester and explore linear and nonlinear effects of weeks of exposure to better environmental conditions on child outcomes.

The medium-term outcomes we examine include grade repetition, drop-out rate, *Baccalaureate* diploma certification, and the total number of *Baccalaureate* credits units in all subjects and in Mathematics and English in particular. The latter outcomes are viewed as a measure of student's ability because they are highly correlated with IQ and of quality of a student's *Baccalaureate* study program. They are also known to have a large payoff in terms of post-secondary schooling and labor market outcomes later in life in Israel. We also examine the impact on birth weight as an early health indicator and the impact on mortality before the age of 12 as a medium-term health indicator.

We find that children exposed to better environmental conditions in utero during the first trimester of pregnancy performed substantially better in all medium-term cognitive outcomes relative to those exposed to these better conditions at a later stage of pregnancy. Children who were in utero in Israel starting from the first trimester are about 12 percentage points more likely to obtain a *Baccalaureate* diploma. This is a large effect since the average *Baccalaureate* rate of children who arrived at the second and third trimester is only 20 percent. Children who arrived to Israel during the first trimester also engage in more challenging study programs during high school. For example, they obtain 3.2 more credit units relative to those who arrived at the third trimester, an effect of about 33 percent. These individuals also attain 0.4 more credit units in Mathematics and 0.5 additional units in English, implying a gain of more than 50 percent. They are also 12 percentage points less likely to repeat a grade and 7 percentage points less likely to drop out of high school. On the other hand, we do not find any effect on birth weight, but we do find that children exposed to better environmental conditions in utero during the first and second trimester are less likely to die before age 12.

We assess the robustness of these results by controlling for birth cohort and seasonality effects. Particularly, we extend our basic model by adding two comparison groups: children of the same birth cohorts from families that emigrated from Ethiopia to Israel prior to "Operation Solomon" and after "Operation Solomon". These analyses point clearly that the positive effect of the better environmental conditions in utero that we estimate is only for children who were in utero in Israel during the critical period (the first trimester) and that cannot be explained by birth cohort or seasonality effects.

Stratifying the sample by gender, we find that the effect on cognitive outcomes is larger and significant mostly among girls and that the effect on mortality is negative and significant only for boys. Finally, in a sort of a placebo exercise, we apply the same empirical strategy and estimate the same treatment effect for immigrants who arrived around the same time to Israel from the Former Soviet Union (FSU), where in utero environmental conditions were similar to those in Israel. Interestingly, and reassuring our main hypothesis, we find that gestational age upon arrival to Israel has no effect on cognitive outcomes among immigrants from the FSU, in sharp contrast with our findings regarding the immigrants from Ethiopia.

This research contributes to the existing literature by investigating the effects of better environmental conditions in utero in different stages of pregnancy on cognitive outcomes. The focus on children of immigrants is particularly important given the large immigration waves from developing to industrialized countries that are observed in recent decades. Our findings on the critical period of in utero conditions have paramount implications for the understanding of intergenerational effects of immigration and have policy implications for developed and developing countries. In the context of rich countries that have become destinations for legal and illegal immigrants from poor nations, it provides rationale for targeting resources at early childhood to children of immigrant families who were born abroad and especially, to pregnant immigrant women. For poor nations, it identifies a pre-birth period where improved conditions can have economically meaningful payoffs in the long-term.

The remainder of the paper is organized as follows. The next section summarizes the related literature. Section 3 provides some background on micronutrient deficiencies during pregnancy in developing countries, describes the historical background of Ethiopian Jews that immigrated to Israel in May 1991, and shows evidence on major environmental differences between their life in Ethiopia and their life in Israel upon arrival. Section 4 describes the data and section 5 describes the empirical strategy. Section 6 presents the results about the effect of environmental conditions in utero on a variety of high school outcomes as well as robustness checks and reports results on birth weight and mortality. Section 7 examines potential alternative interpretations and discusses measurement issues, section 8 assesses the potential longer-term returns and section 9 concludes.

2. Literature on the Effect of in Utero Conditions

The epidemiological literature has explored the fetal origins hypothesis analyzing different effects and timing. Starting with Barker (1992), this hypothesis suggests that certain chronic conditions later in life can be traced to the course of fetal development. Neugebauer et al. (1999) showed that prenatal under-nutrition caused by the Dutch famine after the end of World War II increased the risk for antisocial behaviors in off-springs. de Rooij et al. (2010) found that men and women exposed to this famine during the early stage of gestation performed worse on a selective attention task. Nowakowski and Hayes (2008) and Loganovskaja and Loganovsky (1999) investigated the effect of radiation exposure during pregnancy on cognitive abilities of the off-springs and report that sub-clinical damage caused by radiation to human fetuses between 8 and 25 weeks of gestation can result in cognitive deficits that still manifest 16-18 years after birth. This period of gestation is critical since it is the major neuron genetic period of the developing human neocortex. Other researches have shown that maternal dietary deficiencies of micronutrient like iron, folic acid, and iodine are associated with a variety of poor fetal and infant health outcomes, mostly impacting brain development and function in infancy and often throughout life. Mihaila et al. (2011) links mother's iron deficiency early in pregnancy to profound and long-lasting effect damage to brain development of the child. de Escobar et al. (2007) claims that an inadequate supply of iodine during gestation results in damage to the fetal brain and the birth of many children with learning disabilities may be prevented by advising women to take iodine supplements as soon as pregnancy starts.

Recent studies in economics contribute to the identification of the effects of in utero conditions on later life outcomes by exploiting random and exogenous shocks affecting pregnant mothers. Studies that focus on short term outcomes find that negative environmental shocks have a detrimental effect on fetal health after birth, often measured by birth weight [Lien and Evans (2005), Evans and Lien (2005) Camacho (2008) Currie and Walker (2011)].[2] Most recent studies focus on estimating the effect of environmental conditions in utero on long-term human capital outcomes. For example Almond (2006) reports that children of Influenza Pandemic infected pregnant mothers in the US were about 20% more likely to be disabled and experienced lower educational attainment and wages. Similarly, Lin and Liu (2014) find that cohorts in utero during the Influenza Pandemic in Taiwan are shorter, less educated and more likely to have serious health problems. Almond et al. (2007) report that acute maternal malnutrition caused by the 1959-1961 Chinese famine was associated with greater risk of being illiterate and worse labor market and marriage outcomes. Almond et al. (2009) find that the birth cohort exposed in Sweden to the 1986 Chernobyl (Ukraine) accident radiation between week 8 and 25 of gestation performed substantially worse in school but do not detect corresponding health damage. Banerjee et al. (2010) consider the 19th century blight to French vineyards from the phylloxera insect that decreased wine production and income and find that children born to affected families were 0.5 to 0.9 centimeters shorter in adulthood. Other studies show that infection diseases (Barreca, 2010) and food scarcity (Baten et al. 2007) around the time of birth lead to detrimental educational outcomes later in life.

Our paper is related to these studies by focusing on the link between in utero environmental conditions and later life outcomes. A unique feature of this study is that it is based on a positive event of environmental differences caused by moving from a developing country with poor health care and

[2] Other related studies evaluate the long-term effects of newborn outcomes (e.g. birth weight) on human capital [Currie and Hyson (1999), Behrman and Rosenzweig (2004), Black et al.(2007) and Oreopoulos et al.(2008)].

living conditions to a western country with advanced medical care and better living conditions such as better hygiene and nutrition. One of the main differences that pregnant women faced upon immigration was the supplement of micronutrients. Almond and Mazumder (2011) and Almond et al. (2014) found a positive relationship between appropriate nutrition of the mother during the pregnancy and cognitive abilities of their children in the long term. Field et al. (2009) found that iodine supplementation for pregnant women in Tanzania led to an increase in schooling attainment of children of treated mothers with a larger effect for girls, consistent with laboratory evidence indicating greater cognitive sensitivity of the female fetus to maternal thyroid deprivation. Feyrer et al. (2013) find that salt iodization in the US raised IQ by approximately one standard deviation.

Hoynes et al. (2012) evaluate the impact of the Food Stamps Program (FSP) as a positive policy-driven event that generated an increase in family resources. They find that access to the FSP in utero and in early childhood led to a large reduction in the incidence of "metabolic syndrome" (obesity, high blood pressure, heart disease, diabetes) as well as an increase in self-reported 'good health'. Van den Berg et al. (2012) estimate the effects of changes in environmental conditions of immigrant children to Sweden on height as a proxy to long run health status.

3. Background

3.1. Micronutrient Deficiencies during Pregnancy in Developing Countries

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) states that more than 2 billion people in the world are estimated to be 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 that are relevant for in utero cognition and brain development. The WHO report from 2008 on worldwide prevalence of anemia 1993–2005 estimates that the highest proportion of individuals affected by anemia is in Africa. 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), the rest partly due to deficiency of folic acid, vitamin B12, vitamin A, and due to parasitic infections.

Many important developing processes such as 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 rapidly developing at the time of the deficiency (Kretchmer et al., 1996). Several 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 (Hernandez-Martinez et al. 2011), higher levels of negative emotionality and lower levels of alertness and soothability 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 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 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. A 2004 WHO report notes that almost two billion people (260 million of them in Africa) are estimated to be 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 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 the foods (Ahmed et al., 2012).

Humans require iodine for biosynthesis of thyroid hormone. The thyroid hormones affect the central nervous system development and regulate many physiological processes. In utero, development of the central nervous system required for intellectual functioning depends critically on adequate supply of thyroid hormone, which influences the density of neural networks established in the developing of the brain (Lamberg, 1991). Up to mid-gestation, the mother is the only iodine source for the developing brain of the foetus. An inadequate supply of iodine during gestation results in damage to the fetal brain that is irreversible by mid-gestation unless timely interventions can correct the accompanying maternal hypothyroxinemia. Even mild to moderate maternal hypothyroxinemia may result in suboptimal neurodevelopment (de Escobar et al., 2007).

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 7 years, compared with supplementation later in pregnancy or treatment after birth (Cao et al., 1994). Results from a long term follow-up of this intervention suggests that Iodine supplementation before the third trimester predicted higher psychomotor test scores for children relative to those provided iodine later in pregnancy or at 2 years (O'Donnell et al. 2002). Additional studies also show that iodine treatment late in pregnancy or afterward had no benefits of children's IQ at 5 years of age and under, 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) whereas growth and psychomotor development are believed to be most affected by deficiency in infancy (Cao et al., 1994 and Isa et al., 2000).

Folic acid deficiencies in developing countries are a major public health problem among two high-risk groups: pregnant women and young children. Adequate folic acid (folate) is critical to embryonic and fetal growth developmental stages characterized by accelerated cell division. It plays an important part in the development of the fetus' spinal cord and brain. In particular, folate is needed for closure of the neural tube early in pregnancy (Czeizel and Dudas, 1992, Czeizel et al., 2004). Folic acid deficiency in early pregnancy increases dramatically the chance of a spinal cord problem (Neural Tube Defect) or brain development problems. Therefore, folic acid supplement is advised for at least the first 12 weeks of pregnancy for all women - even if they are healthy and have a good diet. If folic acid supplementation starts after the first trimester of pregnancy, it will not help to prevent these poor birth outcomes. Several human studies 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).

3.2. The Immigration of Ethiopians Jews to Israel[3]

The Ethiopian Jewish community, known also as "Beta Israel", has lived in the region of Northern Ethiopia called Gondar for several centuries.[4] The existence of this remote community became known in the Jewish world only late in the 19th century and they were recognized as Jewish by the state of Israel only in 1975, after the Chief Rabbinate's ruling 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 were brought to Israel in organized immigration projects and become immediately Israeli citizens.

Figure 1 presents the immigration trend of the Ethiopians Jews from Ethiopia to Israel. The pick in 1984 reflects the worsening conditions in Ethiopia due to the 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 begun in November 21, 1984. The Operation involved the air transport of about 8,000 Ethiopian Jews from Sudan via Brussels to Israel, ending on January 5, 1985, when the operation became public and Arab countries pressured Sudan to stop the airlift.

[3] This section is based on Kaplan and Rosen (1994)

[4] After the rise of Christianity in Ethiopia in the fourth century, the Jews who refused to convert were persecuted and withdrew to the mountainous Gondar region where they made their homes for more than 2000 years.

Between 1985 and 1989 the Ethiopian authorities limited the movement of all citizens, Jews included, making immigration 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 Jewery (NACEJ), opened new possibilities to renew immigration to Israel. On May 1990, AAEJ hired busses and brought Jews from their villages at the north of the country to the capital Addis Ababa. Then NACEJ opened a compound in Addis Ababa where Jewish families resided, waiting for permission to fly to Israel. They did not know when they will be going to Israel and accepted the fact that they would be living in Addis Ababa for the time being. However, following political and military turmoil in Ethiopia, and after the Ethiopian dictator Mengistu fled the country in May 1991, the Israeli government decided to airlift the Ethiopians Jews from the Ethiopian capital before rebels take over Addis Ababa. On May 24th 1991, over 14,000 Ethiopian Jews (all the Jewish population who lived in Addis Ababa and almost the entire Jewish population remaining in Ethiopia) were airlifted to Israel within 36 hours (see Figure 2) in an operation named "Operation Solomon". Upon arrival to Israel, the immigrants were placed in absorption centers where they stayed for a few years until they moved to permanent housing.[5] The immigration from Ethiopia to Israel continued after "Operation Solomon" but in small numbers, mainly from rural areas in Qwara near Gondar until 1999. Afterwards the immigration was mainly of the "Falash Mura" people while the last flight of immigrants from Ethiopia to Israel landed on August 2013.[6]

3.3. Environmental Conditions of "Operation Solomon" Immigrants in Ethiopia and in Israel

There are large environmental differences between Ethiopia and Israel that may have affected pregnant mothers. 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 the living conditions, nutrition, micro nutrient supplements, health care, and pregnancy monitoring before and after immigration. We describe below the main differences in environmental conditions experienced by mothers in our sample in Ethiopia and in Israel based on these interviews, the media, and other relevant literature.

Living conditions: Prior to "Operation Solomon", the Ethiopian Jews were still living in hundreds of small remote villages in northern Ethiopia. Their lifestyle, beliefs and occupations were typical of a traditional society. Less than 30 percent of the population was literate in their native languages and

[5] For more details, see Gould, Lavy and Paserman (2004).

[6] "Falash Mura" is a name given to those of the "Beta Israel" community in Ethiopia who converted to Christianity under pressure from the mission during the 19th century and the 20th century. In 2003, the Israeli government gave to those who are descendants from Jewish mothers' lineage the right to immigrate to Israel under the Israeli Law of Return and to obtain citizenship only if they converted to Orthodox Judaism.

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 all over the city, in living conditions not better than in the rural areas they came from. After their arrival to Israel, immigrants were housed in absorption centers (80 percent) and mobile home camps (20 percent) for the first few years.

General medical care: In rural villages local traditional practitioners provided most of the medical care utilizing traditional medications and treatments. The common western perception of disease causation was not common. For many, the first exposure to western medical practices was through the AJDC's medical clinics in Addis Ababa before their evacuation to Israel. Shortly after arrival to Addis Ababa, the incidence of malaria, hepatitis and tuberculosis increased and the AJDC rapidly developed a comprehensive medical program that was implemented in August 20, 1990. The program included immunization and training of Ethiopian health practitioners by Israeli doctors and served approximately 4,000 families. These health services reduced significantly the death rate in the following months (Myers, 1993).

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

Most of the absorption centers had a primary care clinic, which provided medical services to the immigrants. Other centers were in close proximity to a primary health clinic where they were entitled to receive free health care as all Israeli citizens. All clinics were staffed with a family physician, a nurse, an interpreter/mediator and an administrator (Flatau et al., 1993; Sgan-Cohen et al., 1993, Shtarkshall et al., 2009; Levin-Zamir et al. 1993). The medical teams at the primary care clinics provided care of acute and chronic illness and preventive care, which included mother and child health and immunizations (Yaphe et al., 2001).

The Israeli health authorities developed an education health program to bridge the cultural gaps between immigrants and health care practitioners and to promote effectively the transfer of skills to the immigrants regarding proper health care, nutrition, western perception of 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 Central Bureau of Statistics[7]). The traditional Ethiopian diet consisted of unrefined flours, grains, vegetables, refined

[7] Sixty Years in the Eyes of Statistics - Israel's Central Bureau of Statistics (CBS), May 2008, pp.17 [in Hebrew]

sugars, and processed foods and was limited in meat. These eating habits changed upon arrival to Israel as many of the traditional Ethiopian staples were not available at the time in Israel. In the absorption centers in Israel, they were served Israeli style food communally and those who prepared food at home had to use other ingredients, for example, refined white flour instead of teff (Levin-zamir et al, 1993).

Micronutrient supplements for pregnant women: Three main micro nutrient supplements are important for cognition and their intake is recommended for pregnant women: iron, iodine and folic acid. 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.[8] Furthermore, in Ethiopia, according to a situational analysis carried out by the Ministry of Health (MOH) and the United Nations Children's Fund (UNICEF) in 1993, 78% of the total population of Ethiopia are exposed to iodine deficiency and 62% are iodine deficient (Taye and Argaw, 1997). Based on the WHO report from 2004, Ethiopia is categorized among moderately iodine deficient countries and only 20% of the households had salts adequately iodized.[9]

In Israel in contrast, it was a standard practice at that time to prescribe vitamin and iron supplement to pregnant women. Ethiopian women who arrived in operation Solomon agreed to take these supplements even though they thought 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). In addition, there is no iodine deficiency disorders among pregnant women in Israel, largely because Israel's food chain contains adequate amounts of iodine (Benbassat et al., 2004).[10]

Health Care and Pregnancy Monitoring: Ethiopian women who lived in rural areas shared the view that pregnancy does not require medical attention. The Ethiopian immigrant's beliefs that pregnancy outcomes are all at god's will. They gave birth at home with assistance from family and neighbors, and a traditional birth attendant or lay midwife. In contrast, in Israel, pregnancy is closely monitored, the baby and mother are examined periodically before and after birth and almost all births are at hospitals. As a result, most deliveries of Ethiopian babies in Israel were also at hospitals with the assistance of formally trained professionals rather than traditional home delivery practices as in Ethiopia. At the years 1990-1991, the infant mortality rate was 12% in Ethiopia and 1% in Israel and child mortality rate was 20% in Ethiopia but only 1.2% in Israel (The World Bank, 1991). All the women in our survey

[8] Ethiopia Demographic and Health Survey 2011, pp.187.
[9] Ethiopia Demographic and Health Survey 2005, pp.151.
[10] Israel is one of the few western countries that have no iodization policy and where a national iodine survey was not done until 2013, largely because of the perception that Israel is an iodine-sufficient country due to its proximity to the Mediterranean (Zohar, 1994). According to Ovadia et al. (2013) only recently, there is some evidence for inadequate iodine intake in Israel (two thirds of the recommended dietary allowance). A possible explanation is the increasing proportion of desalinated seawater in Israeli's drinking water (desalination plants typically remove 90-98% of soluble minerals, including iodine, from seawater). However, desalination seawater in Israel started few years after the period in our analysis.

mentioned that in Ethiopia they did not receive any medical care related to the pregnancy while in Israel they were under medical monitoring which included blood tests, ultrasound, and vitamin supplements intake (mainly iron and folic acid).

4. Data

We construct a dataset based on the Israeli population registry of all the Ethiopian population in Israel born in Ethiopia or in Israel during the years 1980 to 2005 and their parents. Our data includes their birth date, date of immigration, and country of origin. It also includes the date of immigration and country of origin of the parents, the number of siblings, and the locality of residence of the mother upon arrival to Israel. We also have information on date of death which permit measuring mortality of children until age 12. We merge these data with administrative records on birth weight for children born in Israel collected by the Israeli Central Bureau of Statistics based on hospital deliveries and with data on parent's income from the Israeli Tax Authority. We identify those children whose both parents immigrated to Israel from Ethiopia in "Operation Solomon" on May 24th 1991 and link these data to administrative records collected by the Israeli Ministry of Education which include information on students parental education, yearly schooling status (graduated, currently attending school, dropped out) and high school *Baccalaureate* exams outcomes.[11] We focus on two types of school outcomes; the first measures schooling attainment by the following indicators: repeated a grade after primary school (after 6th grade), completed high school and received a *Baccalaureate* certificate.[12] The second type of outcomes measure quality of schooling attainment and includes the following variables: total credit units awarded in the *Baccalaureate* certificate and credit units awarded in mathematics and English. We also note that total credit units in mathematics and English are highly correlated with IQ (Dvir et al., 2009). We do not use test scores as outcomes because a large proportion of our sample do not sit for the *Baccalaureate* exams or do so only some of them.[13]

[11] More precisely, since the immigration operation lasted 36 hours, we include children whose date of immigration was May 24 or May 25 1991. To simplify writing, we mention in the paper May 24 as immigration date (although we use the exact day – May 24 or May 25 for our calculations of gestational age).

[12] Since our sample includes children born between 1991 and 1992, they all should be high school graduates in 2011 or at least be high school students (compulsory schooling at that time was until 10th grade). A *Baccalaureate* certificate is a prerequisite for admission for academic post-secondary institutions. There are also many employers who require this certificate. Students award a *Baccalaureate* certificate by passing a series of national exams in core and elective subjects during high school years. Students can choose to be tested in each subject at different levels of proficiency, with each test awarding the student between one and five credit units per subject, varying by the proficiency level of the exam (one is the lowest level and five the highest).

[13] Given that all *Baccalaureate* and school attainment outcomes that we examine are binary or count variables, they are also well defined for those who have missing values because they died or dropped out from school. We therefore perform the analysis on educational outcomes using the whole sample of children thus, avoiding selection issues. We discuss this in detail in section 6.5.b where we analyze mortality and assess robustness of our main results.

Our primary sample includes 594 students born in Israel whose pregnancy was incepted in Ethiopia and their mothers immigrated to Israel in "Operation Solomon" (on 24th May 1991). That is, we select students born between May 27th 1991 and February 15th 1992.[14] This yields cohorts that span a different share of time in the living standards of Israel between conception and birth. Table 1 presents summary statistics for the variables used in our analysis for our primary sample and for two other groups of children of Ethiopian origin born at the same period (between May 27th 1991 and February 15th 1992). Column 1 presents means of background and outcome variables for the children in our primary sample, column 2 for the children born in Israel at the same time to Ethiopian parents who arrived to Israel before 1989 (we refer to them as group A – second-generation immigrants from "Operation Moses"), and column 3 for children born in Ethiopia at the same time who immigrated to Israel after 1991 but before 2000 (we refer to them as group B – post "Operation Solomon" immigrants). In our main sample (column 1), the mothers are slightly older at birth relative to the mothers who conceived and gave birth in Israel (column 2) and to the mothers who conceived and gave birth in Ethiopia (column 3). The average mother ages are 30.7, 28.9 and 27.4, respectively. In addition, the age gap between parents is higher in our main sample (column 1): almost 11 years compared to 6.9 (column 2) and 9.4 (column 3) in the other two groups. Parents' average years of schooling is 1.3 and 1.4, which is less than a half of the average years of schooling of parents of children from Ethiopian origin born in Israel during that period (4 for the fathers and 3.8 for the mothers in column 2) but it is similar to the average years of schooling of parents of Ethiopian born children who immigrated with their parents after May 1991 (column 3). These means are much lower in comparison to respective average years of schooling of parents of the Jewish Israeli native students, which are around 12 years of schooling. We also report in the table the mean of family income in 1995, which shows clearly that it is much higher for families that immigrated before 1989. We show below that the mean of this variable is not statistically different across the samples of first, second and third trimesters.

The means of the outcome variables in our primary sample are also lower than those of children born in Israel to Ethiopian parents who arrived to Israel before 1989 (column 2) but they are similar (though marginally lower) to those of the Ethiopian born sample (column 3). For example, the *Baccalaureate* rate at age 18 in our main sample is 30.5 percent, it is 35.1 percent for the Ethiopian origin Israeli born sample (column 2) and it is 32 percent for the Ethiopian born sample (column 3). However, these rates are much lower in comparison to the native Jewish population, 59 percent in 2012.[15] The means of other high school outcomes follow the same pattern. For example, total credit units of the Israeli native population is above 17, while it is around 11.58 for our main analysis sample,

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[14] Assuming 38 weeks of post conception gestation.

[15] Source: Israel's CBS, Statistical Abstract of Israel 2014 (Education – pp.406)

12.85 for children of Ethiopian parents who immigrated previous to "Operation Salomon" and 11.98 for children born in Ethiopia who immigrated with their parents after May 1991. Birth weight and child mortality data is available only for children born in Israel. So we can only compare between "Operation Salomon" offspring and those born in the same period whose parents immigrated in the previous immigration wave. The average birth weight in our primary sample is 3.06 kg while 11 percent were born at low birth weight (less than 2.5 kg) and only 0.5 percent were born at very low birth weight (less than 1.5 kg). The birth weight of children born in Israel to Ethiopian parents who immigrated before 1989 is similar. The mortality rate in our primary sample is 2%, but the mortality rate for the children born in Israel at the same time to Ethiopian parents who arrived to Israel before 1989 is much lower, about 1 percent, a rate similar to the respective rate among the entire Israeli population (The World Bank, 1991).

5. Empirical Strategy

5.1. Baseline Model and Specification

"Operation Solomon" crates a quasi-experimental framework where children of Ethiopian immigrants who shared the same background characteristics and were born shortly after arrival to Israel experienced one important difference: their mothers were at different stages of pregnancy on the day of immigration. That is, all these children experienced the same conditions at birth and at later life but faced dramatic differences in prenatal conditions in utero based on their gestational age upon arrival to Israel in May 1991. This difference was determined solely by the timing of the pregnancy in Ethiopia. Children who were in-utero in Ethiopia for a longer period and were born a short time after their mothers immigrated to Israel on May 1991 ‘missed’ the Israeli environmental conditions in utero and probably suffered more from micronutrient deficiencies of iron, folic acid, and iodine. However, children whose mothers conceived a short time before they immigrated to Israel on May 1991 were in-utero in Israel for a longer period and could benefit from these better Israeli environmental conditions and micronutrient supplements.

In order to estimate the causal effect of these conditions in utero on later life outcomes we assume that children who were born in Israel but whose mothers were at different stages of pregnancy at the time of immigration have the same unobserved characteristics and would have the same mean potential outcomes. The key identifying assumption is that the timing of conception in Ethiopia relative to the timing of immigration was random.

Migration decision and the timing of migration are usually endogenous and correlate with immigrant's characteristics. However, "Operation Solomon" created a different setting of migration since it was an unexpected event, completed in a very short time. The operation was organized by the Israeli government and it brought to Israel almost all Ethiopians Jews who lived in Ethiopia. Thus, the immigrants were not a selected group. Moreover, the timing of immigration was unknown so that pregnancies could not be planned according to migration date and migration could not be planned according to the expected due date.[16] This sudden immigration event generated a unique exogenous improvement to in-utero environmental conditions allowing us to compare between children who were exposed to better environmental conditions at a different gestational age but experienced the same conditions at birth and later life to identify the causal effect of in utero environmental conditions on later life outcomes.

In this paper, we focus on schooling outcomes by age 18-20 which are good measures of cognitive ability and skills. Since the immigration event we study occurred 24 years ago, we are able to observe the schooling outcomes of children who were in utero at that time but it is still too early to analyze their labor market performance. Nevertheless, as we show below, schooling outcomes are a good predictor for adult achievement in the labor market. Our basic identification strategy differs from previous design-based studies in the fetal origins literature. Typically, natural experiments induced by famines, disease outbreaks, or droughts are episodic: they are turned on and then turned off. In contrast, once the mother immigrated to Israel the child was exposed to better environmental conditions of a western country not only in utero but also at birth and for his entire life course.

In order to estimate the impact of in utero environmental conditions on later life outcomes we focus only on children who differ in the timing of exposure to the improved environmental conditions in utero but experienced the same environmental conditions at conception and at birth and later in life. That is, comparison is inherently about additional exposure to better environmental conditions in utero, conditional on being exposed at birth and later in childhood, similar to the approach in Hoynes et al. (2012). We also analyze the effect on birth weight and mortality as outcomes of early life health.

The key variable for our analysis is the gestational age of the child at immigration. The gestational age is measured as the difference between the date of immigration, which is May 24th 1991, and the individual's birth date. We transform the difference into numbers of weeks since it is the common measure for pregnancy duration. The weeks of gestation at the time of immigration (May 24th 1991) are computed assuming 38 weeks of post conception gestation (40 weeks of gestational age).[17]

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[16] It is reasonable to assume that there was no birth planning among the Ethiopian Jewish population before immigration. The contraceptive prevalence rate in Ethiopia in 1990 was only 2.9 percent (Olson and Piller, 2013). Total fertility rate among Ethiopian immigrants was 5.2 (Israel's CBS, 2003). An article published in January 2008 in the daily newspaper "Yediout Hacharonot", claimed that contraceptive injections of Depo-Provera were administered systematically to Ethiopian women before they migrated since the mid 1990's (after the wave of Operation Solomon). We also note that Depo-Provera received the FDA approval only in 1992 and was first approved to be used in Israel as a contraceptive method in 1996. Therefore, it could not affect the timing of pregnancy of women in our samples and has no effect on the cohorts under the analysis in this study. For more information see Fidelman (2013).

[17] The most common measure of pregnancy age is based on gestational age, which counts number of weeks from the last menstrual period. The average pregnancy length computed by gestational age is 40 weeks, which means 38 weeks by fertilization age. Through the paper, we only focus on the 38 week period after fertilization since we do not want to include children whose mothers became pregnant upon arrival to Israel. We therefore drop weeks 0 and 1 of the sample but we still refer to gestational age to be consistent with common nomenclature.

In the medical literature, it is common to divide the pregnancy duration into three periods by trimesters. We therefore define treatment categories by gestational age at time of immigration according to the three trimesters as follows: (1) gestational age between conception time (week 2) and week 12 where exposure to the Israeli environmental conditions started during the first trimester, (2) gestational age between week 13 and week 26 and (3) gestational age between week 27 and birth. These three trimesters can be mapped into three groups defined by date of birth: the first trimester includes children born between December 4th 1991 and February 15th 1992, the second trimester includes children born between August 28th 1991 and December 3rd 1991, and the third trimester includes children born between May 27th 1991 and August 27th 1991. Figure 3 illustrates the definition of the three trimesters according to birth date and estimated conception date. One potential challenge regarding our definition of treatment is that we do not have exact information on conception date and we estimate it using date of birth. This means that we might misclassify some of the children regarding their length of exposure to the Israeli environment. We discuss the issue of misclassification in section 7 and show that our results are robust to potential misclassification of treatment status.

The medical literature, (e.g. Catherine et al., 2009) suggests that the first trimester is a period of rapid growth, and the fetus main external features, including the brain, begin to take form. At the end of the first trimester, all major systems are developed, so this is a crucial time for the development of the offspring. 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 a substantial weight gain. We therefore refer to the first trimester group as the "fully treated" group; the second trimester group is "partly treated" and the third trimester is "untreated". Our basic regression model is specified as follows:

$$(1)\quad y_i = \beta_0 + \beta_1 First\_Trimester_i + \beta_2 Second\_Trimester_i + \gamma X_i^{'} + u_i$$

Where y_i is the outcome of child i. The dummy variables $First\_Trimester_i$ and $Second\_Trimester_i$ are the key explanatory variables. $First\_Trimester_i$ takes the value 1 for children whose mothers immigrated to Israel during the first trimester of gestation (group 1) and $Second\_Trimester_i$ takes the value 1 for children whose mothers immigrated to Israel during the second trimester of gestation (group 2). The omitted category is the third group $Third\_Trimester_i$ which includes children with the shortest exposure to better in utero conditions (i.e. those whose mothers spent most of their pregnancy in Ethiopia). The estimated parameters (β_1 and β_2) reflect the difference between being exposed to better environmental conditions and receiving micronutrient supplements starting from the first or second trimester respectively, relative to the third trimester. X_i is a vector of child i's characteristics which includes mother age at birth, parents age gap, birth order, parents' education, socio-economic index of the mother's first locality of residence upon immigration to Israel, gender, and indicator for twins.[18]

If micronutrient supplements and better environmental conditions in utero enhance cognitive abilities, we expect that children who were exposed to these conditions in utero for a longer period, especially during the first trimester, will have better schooling outcomes. In particular, we expect $\beta_1 > \beta_2 > 0$. The quasi-experimental variation generated by the unexpected date of immigration relative to conception date guarantees that duration of exposure to better conditions in utero is uncorrelated with the residual, thus the parameters β_1 and β_2 can be interpreted as causal.

5.2. Controlling for Cohort and Months of Birth Effects

A potential concern about the baseline specification presented above is that the estimates may be confounded by unobserved cohort effects or seasonality in school performance by month of birth since the students in the full treatment group (first trimester) are younger. Such potential cohort or seasonality effects may be picked by the treatment effect estimates. To address these concerns we look for a comparison group that has no variation in gestational age at migration but was born within the same window of interest. This allows for estimation of birth cohort and seasonality effects in a kind of Difference-in-Difference framework. As discussed in the data section, we define as comparison group A second-generation immigrants from "Operation Moses" (immigrated before 1989) born in the same time window as our main sample. Since the entire pregnancy of children in group A was in Israel, they were all fully treated. Therefore, differences between children born at different months should reflect cohort effects and month of birth (seasonality) effects in Israel. However, since the conception of our main sample was in Ethiopia, seasonality in the timing of conception will not be captured by comparison group A. We therefore add a comparison group B – Ethiopian children born in Ethiopia who immigrated with their families after "Operation Solomon" as a second comparison group.[19] Since the entire gestation period of children of this second comparison group was in Ethiopia, they are all considered untreated and so the difference between children born at 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 month of birth 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 were different in many aspects. However, all the children in our sample – those who were born to parents who immigrated in

[18] The Israel's CBS computes a socio-economic index of the Israeli localities based on several demographic and economic variables such as dependency ratio, average years of schooling of the adult population, percentage of academic degree holders, employment and income levels, etc.

[19] The immigration from Ethiopia to Israel continues after 2000 but we restricted it to the year 2000 in order to include only children who start the Israeli secondary education system in Israel and to exclude the "Falash Mura" people.

"Operation Moses", those who were born to parents who immigrated in "Operation Solomon", and those who were born in Ethiopia and immigrated after "Operation Solomon" - originate from the same country, have the same genetic profile and culture and were raised by immigrant parents. Moreover, they were conceived at the same time as our treated sample. Thus, we expect that cohort and seasonality effects would be similar for these three groups.

To net out seasonality effects from effects that derive from the differences between our main treated group and the comparison groups, we include also children of parents who came in these three different immigration waves (i.e. "Operation Solomon", "Operation Moses" and "post-Operation Solomon") who were born one year before our treated and comparison groups, but at the same months. That is, we add three additional groups of children born between May 27th 1990 and February 15th 1991. The first group includes children who immigrated to Israel with their families on May 1991. These children were "untreated" since they were born in Ethiopia. However, they belong to the same population of our treatment group: "Operation Solomon" immigrants, and therefore have the same family background. The second group includes offspring of Ethiopian parents who immigrated before 1989 and were born in Israel. The third group includes children born in Ethiopia who immigrated with their parents after 1991. The estimated model is then specified as follows:

$$(2)\ \ y_i = \beta_0 + \beta_1 First\_Trimester_i + \beta_2 Second\_Trimester_i + \alpha_1 ETH_i + \alpha_2 pre\_cohort_i + \alpha_3 ETH_i * pre\_cohort_i + \alpha_4 GroupA_i + \alpha_5 GroupB_i + \gamma X_i^{'} + \delta MOB_i + u_i$$

Where $First\_Trimester_i$ and $Second\_Trimester_i$ are the same variables as described for equation (1). $X_i^{'}$ is a vector of child $i's$ characteristics (defined as in equation 1) and MOB_i is a vector of month of birth fixed effects.[20] ETH_i is an indicator for children born in Ethiopia. This includes children who immigrated in "Operation Solomon" (the respective older cohort of our main sample) and children who immigrated after 1991. pre_cohort_i is an indicator for children born between May 27th 1990 and February 15th 1991 (the older cohort). $GroupA_i$ is an indicator for children born in Israel to "Operation Moses" immigrants (the first comparison group) and $GroupB_i$ is an indicator for children born in Ethiopia and immigrated after "Operation Solomon" (the second comparison group). The coefficients β_1 and β_2 represent the treatment effect net of seasonality and cohort effects.

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

6. Results

6.1. 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 within the group of mothers who were already pregnant at the time of immigration. We provide here supporting evidence to this claim by showing that children from the three treatment groups (according to gestational age, in trimesters, at time of immigration) are not different in their background characteristics. In addition, we show that the frequency of births in the three trimesters is similar to the observed frequencies in the two comparison groups who were born during the same period of interest.

Table 2 presents summary statistics for background characteristics by the three trimester groups. Column 1 presents means of background variables for the children whose mothers arrived to Israel at the earliest stage of the pregnancy (during the first trimester). Column 2 presents the respective means for the children whose mothers arrived to Israel during the second trimester, and column 3 presents characteristics for children whose mothers arrived during the third trimester. The median gestational age is roughly in the middle of the range for each group, so no group suffers from over-representation of only one part of the period. Columns 4, 5 and 6 report the difference in means and their standard errors between these three groups and column 7 reports estimates where each of the characteristics is regressed on weeks of gestation upon immigration to assess whether there is a systematic relationship between immigration at an earlier stage in pregnancy and family background.

Differences in parental education between children who arrived in the different trimesters are not statistically significant, except for a disadvantage of mothers who arrived in the first trimester relative to the second. So overall, this works against our concern for a positive selection bias if better family background correlate with arrival to Israel at earlier stages of pregnancy. The mean SES index of the initial locality of residence of the mother upon immigration is also lower for the first trimester group (though not statistically significant). On the other hand, the family annual income four years after immigration is slightly higher in the first trimester group by more than 1,000 NIS (equal to $250) compared to the second and third trimester groups. However, differences in income are not statistically significant. Unfortunately, family income in 1995 is the earliest year available in the administrative income data. Therefore, since this income variable is measured post treatment, we do not include it as a control in the regressions.

The proportion of girls in the first and the third trimester is the same (0.462) and it is lower from the second trimester (0.506) but these differences are insignificant. There are also no significant differences in mother’s age at birth, mother’s age at first birth, number of siblings, birth order, and birth-spacing. The mean of parents age gap in the first trimester group is 9.9 which is significantly lower by 1.5 years from the second trimester group, and it is also lower by almost 1 year from the third trimester group, although this last difference is insignificant.

Overall, differences in parental characteristics and family structure do not point to any particular advantage of one group relative to the others. Moreover, as reported in column 7, there is no clear trend showing an association between better family background and a longer exposure in utero to the Israeli environment (e.g. arrival at earlier stages of pregnancy).

The results presented in this table support our claim that exposure to treatment is indeed as good as randomly assigned in this natural experimental setting, by showing that children from the three trimesters groups are not different in their observable characteristics. Specifically, they show that there is no significant correlation between the observable characteristics of children and the timing of pregnancy according to our definition of the three "treatment" groups. Of course, the absence of such statistically significant correlations is not a full proof for treatment status being random but lack of correlations with observables raises the likelihood of no correlation between treatment status and unobservable confounders.

Figure 4 plots the frequency of births of our main analysis sample ("Operation Salomon" children) and the comparison groups who were born in the same period, group A and group B by month of birth and the stratification by trimesters. As can be seen in the figures, frequency of births in the three trimesters is similar in our main sample and the two comparison groups and there is no clear evidence of selection of births across the trimester cutoffs.

To look at this issue in a higher resolution, we plot in Figure 5 the share of births by gestational week upon immigration to Israel (May 24th 1991) for our main analysis sample and the equivalent gestational age computed at that same date for the two comparison groups. The vertical lines denote the trimesters. The figure shows two important facts: (i) there is no clear discontinuity around the trimester cutoffs in our main analysis sample; (ii) The share of births by week is not significantly different between our main sample and the two comparison 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 trimesters between our main sample and the two comparison groups. Results (not reported here but available upon request) show no significant differences in none of the three trimesters.

6.2. Main Results

First, we discuss the results for our baseline model without controlling for seasonality effects. Table 3 presents the results for our baseline model (equation (1)) with and without controls for students' observable characteristics. In all specifications, the omitted category is the third trimester group. Columns 1, 3, 5, 7, 9, and 11 present estimates for equation (1) without controls and columns 2, 4, 6, 8, 10 and 12 present estimates for equation (1) including controls. We report the estimates of β_1 and β_2, and a p-value for the test of equality of these two coefficients.

The estimates reported in columns 1 through 6 show that exposure in utero to micronutrient supplements and to the Israeli environmental conditions starting from the first trimester of pregnancy has positive and significant effects on schooling attainment relative to a late exposure at the third trimester. Students who were exposed to this treatment starting from the first trimester (group 1) are 10.3 percentage points (s.e.=0.036) less likely to repeat a grade during high school and 5.4 percentage points (s.e.=0.038) less likely to drop out of high school before completing 12th grade compared to students exposed to treatment only during the third trimester (group 3). These effects increase slightly to 11.8 percentage points (s.e.=0.038) and 6.9 percentage points (s.e.=0.039) respectively when controlling for background characteristics. Exposure to treatment during the second trimester is also associated with lower likelihood of grade repetition and school drop-out compared to the third trimester, but the effects are much smaller than those obtained for exposure from the first trimester and are not significant. On the other hand, we cannot reject the hypothesis of equality of coefficients between the effects of the first and second semester, probably due to a lack of power.

The average rate of high school completion in our sample is 85 percent. Therefore the above estimate means that exposure to better in utero conditions in Israel from the first trimester improves graduation rate by 8 percent. This effect is slightly higher relative to other studies that estimated the effect of prenatal exposure on cognitive outcomes. For example, Field et al. (2009), who also investigate the effect of in utero micronutrient supplement (iodine), find that that intensive iodine supplementation for pregnant women in Tanzania increased schooling by half a year, a 6 percent increase. Almond (2006) found that prenatal exposure to Influenza Pandemic reduced schooling by 0.25 year (2.3 percent relative to an average of 10.6 years of schooling) and the likelihood of completing high school by 0.03 percentage points (6 percent relative to an average rate of 48 percent).

Performance in the *Baccalaureate* exams is also improved by a longer exposure to treatment. Students who were exposed to the Israeli environment starting from the first trimester are 12 percentage points (s.e.=0.052) more likely to obtain a *Baccalaureate* diploma by the end of high school compared to students exposed in the last trimester. This effect is twice the size than the effect of arriving during the second trimester although not statistically different.

The estimated effect for the fully treated group (first trimester) on the *Baccalaureate* rate is very large relative to the mean of this outcome in the two other groups, which is about 20 percent: it means that treatment exposure from the first trimester improved the *Baccalaureate* rate by 65 percent. This is a dramatic effect size in absolute terms and relative to any studied and well identified educational program. Moreover, as we discuss in the data section, the *Baccalaureate* rate in our sample is substantially low compared to the *Baccalaureate* rate among all Jewish students in Israel and the additional 12 percentage points for the fully treated group represents almost half way of closing this gap. This effect is twice the effect of attending a high versus low quality primary school among Ethiopian students in Israel (Gould et al. 2004). Other related studies that examined prenatal exposure to negative shocks like malnutrition and alcohol exposure found negative effect of 20 percent on test scores (Almond et al. 2014 and Hinke Kessler Scholder et al. 2014).

The above gains are accompanied by improvements in other measures of quality of the high school *Baccalaureate* study program as shown in columns 7 through 12. The total *Baccalaureate* credit units of children who arrived in the first trimester are 3.3 points higher (s.e.=1.047) than those of children who arrived in the third trimester, a gain of almost 40 percent. The Math and English credit units are up by about 0.4 and 0.5 units, a gain of about 30 percent. These are important and large quality gains. The effect of the second trimester is positive and significant (except for Math) and smaller than the effect of the first trimester although we cannot reject the hypothesis of equality between these two effects.

Table 4 presents the results for the DID specification (equation (2)) that controls for cohort and month of birth fixed effects. The DID estimates for the schooling attainment outcomes are very similar to the respective OLS estimates and are more precise except for the estimates for obtaining *Baccalaureate* diploma by the end of high school which are smaller and less precisely estimated. (The estimate for obtaining *Baccalaureate* diploma by the end of high school is smaller. Is it also less precise? I guess not, but perhaps it could be misunderstood from this sentence). The DID estimates for the quality of the *Baccalaureate* program are slightly lower from the respective OLS estimates but not statistically significant different. Again, the results suggest that early exposure to better in utero environmental conditions improve the quality of the *Baccalaureate* diploma. For most of the outcomes, after controlling for seasonality and cohort effects, we obtain significant differences between the effects obtained in the first trimester and the second trimester probably due to the increase in precision. While the impacts of the first trimester are large and significant, the impacts of the second trimester are smaller and not significantly different from the impacts of the third trimester. These results suggest that the first trimester of pregnancy constitutes a critical period for cognitive development.

In Table A1 we explore an alternative simpler specification where we estimate a linear model using as a main explanatory variable the gestational age (in weeks) at time of immigration. As in our main sample, we include weeks 2 through 40 of gestational age since weeks 0 and 1 include children who were conceived in Israel. In line with our main results from the specification stratified by trimesters, the estimate for gestational age is negative for all outcomes suggesting beneficial effects for earlier exposure to better in-utero conditions. This model however, assumes a constant marginal effect by number of weeks of exposure and does not allow capturing the differential effects of the different gestational periods. We also experimented with additional specifications where we included higher order polynomials instead of a linear effect but their fit to the data was inferior (lower adjusted R-squared and higher AIC values). We also estimated a model that included both a week linear effect and trimester dummies. In these models, the standard errors are much higher because of the high correlation between these covariates but the estimated effect size for the trimester dummies are almost unchanged and remain statistically significant, highlighting the nonlinear effect by trimester. We also tried specifications that 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 (594 children).

6. 3. Heterogeneity in the Effect of In-utero Environmental Conditions by Gender

Table 5 presents estimates by gender for our two main specifications: the baseline OLS and the DID controlling for students background characteristics. We also report the means of the outcome variables for each sample and the p-value of the difference in the coefficient between boys and girls. Results reported in columns 1, 3, 5, 7, 9 and 11 of table 6 are based on equation (1) (OLS model). Results reported in columns 2, 4, 6, 8, 10 and 12 are based on equation (2) (DID model). The estimates of the effect of earlier exposure to better environmental conditions in utero reveal an interesting differential pattern by gender. We observe a large impact of exposure in the first trimester for girls in all outcomes. In contrast, the impact for boys is smaller and not statistically significant. Differences in magnitude of the estimated effects between boys and girls are not always significant but all estimates point to the same overall pattern: exposure to better environmental conditions in utero starting from the first trimester dramatically improves outcomes for girls but not for boys. In addition, we observe a smaller but still positive and even sometimes significant effect for girls in the second trimester while there is no equivalent effect for boys. However, it could be that early exposure to better environmental conditions improves boys' outcomes in other dimensions not analyzed here.

Evidence for a larger impact for girls is consistent with the findings of Field et al. (2009) who also investigate the effect of in utero micronutrient supplement (iodine) and find larger improvements for girls. Our results are also consistent with other related literature. For example, Baird et al. (2011) find that in developing countries girls infant mortality is significantly more sensitive to aggregate economic shocks during pregnancy relative to boys. In addition, studies that analyzed long term outcomes of negative environmental shocks found higher effects on girls. For example, Oreopoulos et al. (2008) show that effects of infant health on reaching grade 12 by age 17 appear to be stronger for females than males. Hoynes et al. (2012) find that increasing family resources during early childhood improve health at adulthood for both men and women but have positive significant effect on economic self-sufficiency only for women. Gould et al. (2011) also find that early childhood living conditions affected only girls among families that emigrated from Yemen to Israel in 1948-49. The positive effect on girls that they found was evident in short term outcomes such as schooling and in long term outcomes such as employment and earnings at age 55-60.

Why are the effects on girls larger than the effects on boys? Recent scientific 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 the effect of artificially restricting maternal thyroid hormone in utero on fetal neurodevelopment and behavioral outcomes was significantly larger in female relative to male rat progeny. Although the mechanism underlying sex-selective effects of maternal nutrient deprivation on brain development 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. Less conclusive evidence of biologically-driven gender differences in iodine sensitivity based on human studies includes earlier studies, Bautista et al. (1982) and Shrestha and West (1994). The gender differences we observe in the impact of the gestation period in Israel may reflect physiological differences in the importance of iodine for fetal brain development similar to those observed in animal studies. Field et al. (2009) suggest the same explanation for their finding that reducing the deficiency of iodine among pregnant women had a large impact on girls schooling but not on boys.

There is also a medical literature assessing the differential effects of iron deficiency in utero by gender based on animal models. Consistent with our findings, Kwik-Uribe et al. (2000) find that iron deficiency is more detrimental for female mice fetuses as it was possible to totally reverse this deficiency for male mice by 8-week of postnatal iron supplementation while not for female mice. One explanation offered by the authors is that the ovarian hormones modulate dopamine metabolism and function, contributing to the appearance of gender-specific biochemical responses. A more detailed examination and discussion of the physiological mechanisms that lead to the different effects by gender is beyond the scope of this paper and is addressed by the medical literature.

6.4. Placebo Tests

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 same time of "Operation Solomon" but from a more developed part of the world where in utero conditions at that time were similar to Israel. We implement this idea by focusing on a sample of immigrants who arrived to 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 were the immigrants lived) were relatively similar to those in Israel.[21] In addition, parental background characteristics of children of FSU immigrants are not different from the Israeli

[21] More than 80% of the FSU immigrants arrived from the European republics, mainly Russia and Ukraine, and mainly from urban areas (Israel's CBS2001). 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) (). Pre-natal care in FSU was also relatively similar to Israel (The World Bank, 1991). Until the deterioration of the Soviet Union there was iodization of salt policy (Van der Haar et al.2011). Also, anemia in pregnant women has increased significantly only after the collapse of the Soviet Union (Sedik et al. 2003).

native population. For example, parental years of schooling of FSU immigrants in these years were 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 select all children whose mothers were pregnant upon arrival to Israel from the FSU in 1991-1992. We define the treatment groups in the same way we define the original treatment definition. We compute the gestational age of the child at immigration as the difference between the date of the mother immigration and the child's birth date. For example, $First\_Trimester_i$ equals 1 if the mother immigrated to Israel during the first 10 weeks after conception. Unlike "Operation Solomon", immigration from FSU did not take place in a single date, 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 within this sample.

In Appendix Table A2 we perform balancing tests for this sample where we regress students' background characteristics on the trimester indicators while controlling for month and year of birth fixed effects. The results show no evidence for differential selection in the timing of immigration according to gestational age. Namely, parental schooling, number of siblings and the proportion of boys is similar for children who were in utero at different trimesters of pregnancy upon immigration.[22]

Table 6 presents estimates for the effects of exposure in the first and second trimester based on equation (1) with year and month of birth fixed effects, under two specifications, without controls and with controls. The two specifications include cohort and month of birth fixed effects. The controls include parents' years of schooling, gender and number of siblings. The treatment estimates are much smaller, most of them very close to zero, and they are all insignificant relative to the results obtained for Ethiopian immigrants. Overall, we can safely conclude that these placebo tests show no systematic association between gestational age at time of immigration and outcomes among children who were born in the same period of interest but did not experience a significant change in in-utero conditions upon immigration to Israel. These results show that our main findings for Ethiopian children are unlikely to be confounded with other factors that could be associated with date of birth and could affect students' outcomes.

In Table 7 we present similar placebo evidence while stratifying the FSU sample by gender given that our main results for Ethiopian children were mainly concentrated among girls . In sharp contrast to the results for Ethiopians, there are no effects for boys and for girls. All estimates are small and are not statistically different from zero.

[22] We cannot use the richer set of covariates that we used for the Ethiopian sample, since we only have the administrative data from the ministry of education for the FSU sample. Nevertheless, since we find no evidence for differential selection in none of the available covariates, it is reasonable to assume that it is unlikely to have selection in other covariates or unobserved characteristics.

6.5. Effect on Additional Outcomes

a. Birth outcomes

As discussed above, the medical literature stresses the crucial role of maternal health and in-utero conditions during the first trimester since the fetus develops all of its organs in this period. In particular, the first trimester is crucial for brain development. In light of this, we explore whether exposure to a better environment from the first trimester has effects also on early life health. We explore the effect of length of exposure to the Israeli environment on birth weight as a proxy of fetal health.

Table 8 presents the estimates of the treatment effect on birth weight (measured in grams) for the baseline OLS specification and a DID specification that includes only the cohorts born in Israel between May 27th 1991 and February 15th 1992.[23] In addition, the table shows estimates for the probability of low birth weight (less than 2500 grams). [24] We also report means of the outcome variables for each sample. Results reported in columns 1, 2, 5, and 6 of the table use our main analysis sample and are based on estimation of equation (1).[25] Results reported in columns 3, 4, 7, and 8 include, in addition, children from Ethiopian origin born in Israel during the same period whose parents immigrated before 1989 (comparison group A). The model for this extended sample controls also for month of birth fixed effects and includes an indicator for comparison group A. Estimates from the OLS model show some positive effect on birth weight for children born in the first and second trimester. However, the effects are negative and insignificant when we focus on low birth weight as an outcome. Moreover, estimates from models that control for month of birth fixed effects are small and not different from zero.

In Table A3 we present the results on birth weight by gender. Most estimates for girls are not significant. Actually, we find a positive effect for those who arrived during the first trimester on the likelihood of low birth weight, which goes against our findings of better cognitive outcomes. Estimates for boys show some positive effect on birth weight from exposure in the second trimester but no effects from the first trimester.

Overall, results reported in Table 8 and Table A3 suggest that the large effect of early exposure to better prenatal conditions on schooling outcomes is unlikely to be derived from improved fetal health. It also reduces the concerns that our estimated effects on schooling outcomes are due to positive selection of births in the first trimester since if selection is driving our results, we should see this also in terms of an effect on birth weight.

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[23] We include only cohorts born in Israel because there are no administrative records on birth weight of children born in Ethiopia.

[24] There are very few observations with very low birth weight (less than 1500 grams) and therefore, we do not estimate the effect on this outcome.

[25] The sample size is smaller since we have 10 observations with missing values for birth weight. We did not find any correlation between having missing birth weight and the three trimesters' indicators (results not reported here but available upon request). This indicates that these 10 missing observations are unlikely to affect our results.

Our results of no effect on birth weight are in line with other studies that examine the effect of environmental conditions in utero on long-term human capital outcomes that did not find effects on fetal and later life health. For example, Field et al. (2009) showed that delays in iodine supplementation during pregnancy have large and robust educational impacts, but no effect on health at school age. Almond et al. (2009) found that radiation exposure between week 8 and 25 of gestation harmed school achievement but do did not affect birth weight and hospitalizations.

A possible explanation for our lack of results on birth weight is that higher exposure to all the three micronutrient supplements (iron, iodine, and folic acid) affects brain development at the first trimester while all other improved environmental conditions have a positive effect on nutrition even if exposed during the second or third trimester. The evidence documented in Akter et al. (2012) which shows that nutrition counseling among urban poor women in Bangladesh during the third trimester of their pregnancy reduces the probability of low birth weight supports this interpretation.

b. Mortality

A second important health outcome that we examine is mortality (under age 12). Overall, given the small sample size, we observe few mortality cases: two children from the first trimester, two from the second, and eight from the third died before reaching age twelve. Table 9 reports differences in mortality rates by trimester for the baseline OLS specification and a DID specification that includes only the cohorts born in Israel between May 27th 1991 and February 15th 1992.[26] The table presents the estimates of the treatment effect on mortality for the full sample and for boys and girls separately. Estimates in columns 1, 2, 5, 6, 9 and 10 come from our simple OLS models (equation 1) and estimates in columns 3, 4, 7, 8, 11, and 12 include, in addition, children from Ethiopian origin born in Israel during the same period whose parents immigrated before 1989 (comparison group A). The model for this extended sample controls also for month of birth fixed effects and includes an indicator for comparison group A. We also report means of the outcome variables for each sample and the p-value of the difference in the coefficient between the first and the second trimester and between boys and girls.

The results of the full sample show that children who arrived in utero to Israel during the first or second trimester were significantly less likely to die relative to those who arrived during the last trimester. Results stratified by gender reveal that the negative impact comes mainly from boys. Estimates for girls are also negative but smaller in magnitude and insignificant although we cannot reject the hypothesis of equality in the coefficients between boys and girls. This finding suggests that early exposure to better in utero conditions reduced mortality among boys. A reduction in mortality without an effect on birth weight is consistent with evidence from other studies such as Almond et al. (2005). Our findings suggest that arrival during the first or second trimester had beneficial health

[26] We include only cohorts born in Israel since for cohorts who did not born in Israel we might miss children who died in Ethiopia.

effects for boys but improved cognitive outcomes are present only for girls if arrival takes place during the first trimester. We caution however that the difference in the results by gender is driven by only 2 observations: the same number of boys and girls died in the first and second trimesters but in the third trimester 5 boys died versus 3 girls).

The reduction in mortality rates for boys in the first and second trimester raises the concern that a negative selection could potentially explain the smaller or zero effect we estimate for boys on cognitive outcomes. The higher mortality among children who arrived in the third trimester implies that the remaining sample of children born in the third trimester includes less 'marginal' children relative to the first two trimesters. However, as noted above, in our analysis on cognitive outcomes we include all children who died and assign them the worst possible outcome (which is zero given that all outcomes are either binary or count variables). This imputation is in the spirit of Horowitz and Manski (2000). In any case, given the very small number of children who died by age 12, our main results are unlikely to be driven by selection due to differential mortality. We show this in table A4 where we replicate our main results by gender on cognitive outcomes as in table 5 while excluding the children who died. The estimated coefficients for boys and girls are not significantly different from the estimates presented in Table 5. The estimated effect on boys is still not significantly different from zero even though we dropped from the sample the 'marginal' children. Estimates for girls are positive with a larger effect for the first trimester as our main results. This clearly suggests that our findings of no effect on cognitive outcomes for boys are not driven by inclusion of 'marginal' boys in the sample. This is not a surprising conclusion given the very small number of mortality cases in our sample.

7. Alternative Interpretations and Measurement Issues

Our results show that children with a smaller gestational age at the immigration day had better outcomes relative to those whose mothers arrived at more advanced stages of pregnancy. We interpret this as a positive impact of in-utero conditions. An alternative interpretation is that mothers who arrived at an earlier pregnancy stage had more time to adjust and prepare for birth and were able to build social networks to get proper assistance and care for their newborns. We think that this explanation is unlikely because all new Ethiopian immigrants were placed in absorption centers where they stayed for at least 18-24 months. In these centers, immigrants received assistance from social and health workers and conducted their social life. Therefore, we can safely assume that all women who gave birth within the nine-month window upon arrival to Israel received the same post-natal care and had the same social network.

We provide additional evidence that rule out this alternative interpretation. In Table A5 we present estimates that show that the length of stay in Israel did not affect child outcomes. We derive this evidence by examining the outcomes of Ethiopian children born to “Operation Salomon” mothers who were conceived in Israel and born within 10 to 20 months after the mother arrival to Israel. We cannot extend this time window more than 20 months because the additional children that will be included in the sample are too young and do not yet have end of high school outcomes. In addition, we want to include in the sample children conceived within a short time from the immigration date to make sure that their mothers were all still in absorption centers and therefore received similar prenatal care.

We estimate OLS regressions of all outcomes on mother's weeks in Israel at the time the child was born. The regressions control for the same family background characteristics that we include in all our previous models. Even though pregnancy in the sample we use here could be endogenous, we believe that, if anything, such selection may bias the estimates of the effect of time in Israel upward because mothers who choose to wait and get pregnant only after they gained some experience in Israel might have better unobservables. The evidence we present in Table A5 show that mother's length of stay in Israel at the time the child was born has no significant and systematic effect in none of the child's outcomes that we examine: the estimates are small, varying in sign, and not statistically significant. This evidence mitigates the concern that our results are driven by the length of stay in Israel of mothers who arrived during the first trimester of gestation.

Stress could be another potential confounding factor. Children in utero at immigration date could be affected by maternal stress during this event. Several recent studies emphasize the negative impact of maternal stress on child outcomes. Aizer et al. (2015) and Persson and Rossin-Slater (2015) find that in utero exposure to maternal stress has detrimental effects on children's cognitive outcomes and mental health. Black et al. (2016), however, find small adverse effect on birth outcomes and no effects on education and earnings among children whose mothers lost one of her parents during pregnancy. These studies, however, do not examine the differential effect of maternal stress by gestational age. Some medical studies shed light on this issue, for example, 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) also 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. King et al (2012) provide also similar evidence, concluding that stress exposure is more detrimental in early stages of pregnancy. These findings are consistent with non-human primate studies, which also demonstrate a stronger detrimental effect of maternal stress on birth weight and neuro-motor functioning during early gestation compared to mid-late gestation (Schneider et al. 1999).

Overall, the medical literature points to a more detrimental effect of stress on cognitive functioning during early gestation as opposed to exposure on late gestation. Therefore, if the effect of stress during immigration follows the same pattern, it works against finding an effect of improved in utero conditions during the first semester. Additional evidence that reduces the possibility that our results are explained by differential exposure to stress is that we do not find any difference in sex ratios between children born in the first and the third trimester while various studies have found that maternal stress increases the chances of male miscarriages (see e.g., Liu et al., 2015 and Kraemer, 2000). We also find no differences in birth weight by gestational age at arrival to Israel even though the stress literature shows that maternal stress also causes lower birth weight (King et al. 2012).

Additional challenges to our design derive from measurement issues. Unlike recent studies that measure gestational age based on clinical records on last menstrual period or ultrasound scan during the first trimester, we compute gestational age based on date of birth. The implications are that we might misclassify some of the children who were born preterm and assign them to the wrong trimester of gestational age upon arrival to Israel. The question is whether we are more likely to have more misclassifications or preterm births in a specific trimester. We suspect that this is not the case since we find no associations between the trimester of gestation upon arrival to Israel and birth weight (which is a good proxy for preterm births). Still, a valid concern 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 be born in February or late January 1992. We therefore stratify the first trimester into three groups: weeks 2-4, weeks 5-8 and weeks 9-12 of gestation and estimate our main models examining the differential impacts of different periods in the first trimester. Estimates reported in Appendix Table A6 show that the beneficial effects of the first trimester do not particularly come from the first weeks after conception, reducing the concern that our results are derived from misclassified preterm children who were actually conceived in Israel.

We further examine the robustness of our results to misclassification of births by trimester by re-estimating our two main models assuming different possible scenarios. Results are reported in Appendix Tables A7, A8, and A9. We first re-estimated the models using samples that excluded births from the first two weeks of each trimester and a sample that dropped births from the first two weeks of all trimesters (Table A7). These samples exclude possible late term or post term births. Next, we repeated the exercise using samples that exclude births that took place in the last two weeks of each trimester (Table A8). In this case, we consider misclassifications of pre-term births. Last, we re-assigned the first or last two weeks of each trimester to the previous or next trimester (Table A9). Estimates from the different alternative samples are very similar to our main set and suggest that our results are unlikely to be driven by misclassification of births.

Another data concern is that we do not observe miscarriages or stillbirths. If these events were more likely to occur to mothers who arrived to Israel during the first trimester, they may have caused the sample of children who arrived in the first trimester of gestation to be positively selected. With regard to this concern, we first note that if indeed the first trimester sample is positively selected then it should have a higher mean birth weight relative to the other two samples (second and third trimester). However, this is not the case. Second, since boys are more likely to be miscarried and die prematurely in hard times, we expect that if there were more miscarriages and stillbirths among mothers who arrived in their first trimester, we should observe a lower sex ratio (males to females) for the first trimester sample relative to the third trimester. However, as shown earlier in section 3, the sex ratio of children in the first trimester is equal to that of the third trimester. Third, as discussed above, we do not find significant differences in the share of births by calendar week between our main analysis sample and the two comparison group samples. Last, we think that if anything, the better environmental conditions upon arrival to Israel might have lowered the incidence of miscarriages among women who arrived at earlier stages of pregnancy relative to those who arrived at a later stage as found in the mortality analysis. In that case, we should actually observe more marginal children born among mothers who arrived in their first trimester, a fact that works against finding a positive impact on longer term cognitive outcomes for this group.

8. Potential Longer Term Returns

What are the longer term economic payoffs at adulthood of the gains due to the better in utero environmental conditions? Since the individuals in our sample are now only 23 years old, we do not yet observe their post-secondary schooling and labor market outcomes. Hence, we examine the relationship between improved high school outcomes, and post-secondary schooling and earnings based on older cohorts born in Ethiopia between 1981 and 1984 who emigrated from Ethiopia during Operation Salomon. Note that individuals in this sample arrived to Israel at ages 7 to 10 and therefore received most of their schooling in Israel. We use administrative records provided by the National Insurance Institute of Israel (NII) which include information on post-secondary enrollment and earnings. We linked these data to administrative records collected by the Israeli Ministry of Education, which include information on individuals' *Baccalaureate* outcomes.

Table 10 presents the relationship between *Baccalaureate* outcomes as explanatory variables, and post-secondary schooling and earnings by the ages 28-31. All the estimates are based on regressions that control for gender, parents years of schooling, number of siblings and year of birth. Column 1 shows the estimates for any type of post-secondary schooling enrollment and column 2 shows the equivalent estimates for university enrollment.[27] Individuals with a *Baccalaureate* diploma are 26.3 percentage points more likely to continue schooling in some type of post-secondary schooling and 11.4 percentage points more likely to enroll to university. The total credit units in the *Baccalaureate* study program, the number of advanced courses, and the number of credits in advanced science classes (4 and 5 credit units) are also positively and significantly associated with each of the two higher education outcomes.

Column 3 shows the estimates from a regression of the *Baccalaureate* outcomes on monthly earnings in 2012. Individuals with a *Baccalaureate* diploma earned about 580 shekels more a month

[27] In Israel, post-secondary schooling includes universities, colleges and professional colleges. Admission to university is much more selective relative to all other post-secondary institutions in terms of the quality of the matriculation program required.

(about $145), or 12 percent more relative to the outcome mean. An additional credit unit in the *Baccalaureate* program is associated with 36 shekels (about $9) and a respective unit in advanced science courses is associated with 132 shekels ($33) although this estimate is imprecise. An additional advanced course is associated with 230 shekels ($57). Estimated returns to *Baccalaureate* outcomes are much higher for females than for males but this is due to the fact that males serve longer in the army and begin their post-secondary education at an older age. Thus, returns to education among men may still not be fully realized.

These estimates cannot be interpreted as causal but they are economically meaningful and most are also precisely measured. Even though these estimates are much lower than the respective estimates obtained from a sample of native Israelis, they are much larger than the cost of providing the better in utero environmental conditions, particularly the cost of the three micronutrient supplement - iron, iodine and folic acid, during pregnancy. Of course, a proper cost-benefit analysis of the rate of return to these pre-birth investments must rely on causal relationship while ours are simple associations, and it should also include an estimation of the costs of providing prenatal care. In addition, it is important to note that because of the military service (three years for men and two years for women) many individuals in this sample might still be enrolled in post-secondary schooling. Therefore we might not be observing a full time employment and earnings, mainly for men.

9. Conclusions

This paper examines the role of in utero environmental conditions and micronutrient supplements (mainly iron, iodine and folic acid) on offspring cognitive achievement. The analysis is based on exogenous variation in environmental conditions in utero caused by the sudden immigration of Ethiopian Jews to Israel in May 1991. Children, who were already in utero at the immigration date, were exposed to better environmental conditions upon arrival to Israel. Some children were exposed to these better conditions from the early weeks of gestation while others were exposed to these conditions only at the last stage of their mother’s pregnancy. We exploit this variation to examine the relationship between weeks of in utero exposure to better environmental conditions and high school outcomes. We also examine the impacts on birth weight and mortality.

The results suggest that children who were exposed to micronutrient supplements and to better environmental conditions in Israel during the first trimester of pregnancy had substantially higher educational outcomes by age 18 relative to those exposed to these conditions at later stages of pregnancy. The higher educational outcomes include a lower likelihood of school repetition and dropout, a higher likelihood of obtaining a *Baccalaureate* diploma and of graduating with a higher quality *Baccalaureate* study program. The impact is significantly larger for girls. The effects sizes are very large, especially compared to the low counterfactuals for this group. Moreover, the expected gains are high in terms of the relationship between *Baccalaureate* outcomes and post-secondary schooling and earnings at adulthood. These results are robust with respect to alternative comparison groups that attempt to control for seasonality of births and cohort effects. We find no effect of early exposure to better environmental conditions in utero on birth weight. This result is consistent with the fact that fetal growth and weight gain takes place in the second and third trimester so that children who immigrated during more advanced stages of gestation were able to catch up on this outcome. On the other hand, we find that arrival during the first or second trimester reduced mortality rates but this negative effect is observed only for boys.

This paper adds to the growing economic literature investigating the fetal origin 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 style economy. As such, our estimates (especially for girls), can be viewed perhaps as an upper bound on what a full (in utero) early-childhood development 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 the developing countries. In addition, the evaluation of the impacts of differences in environmental conditions in utero between developing and developed countries can shed light on the early origins of gaps in human capital and health outcomes.

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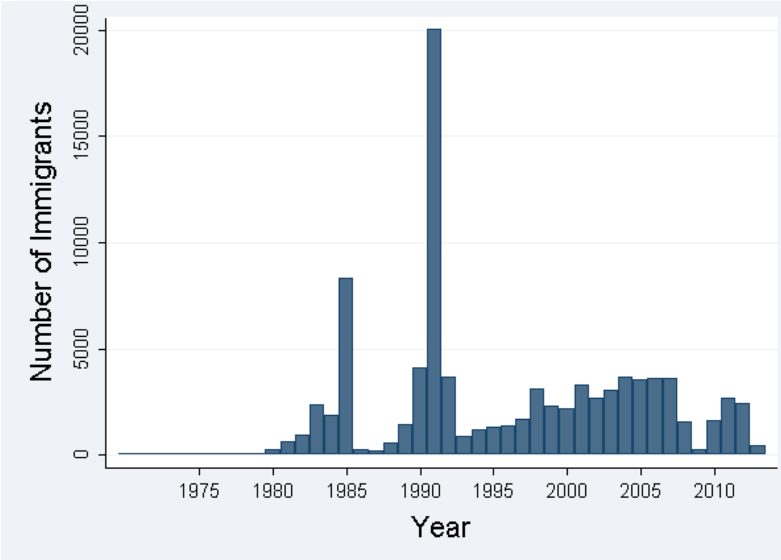
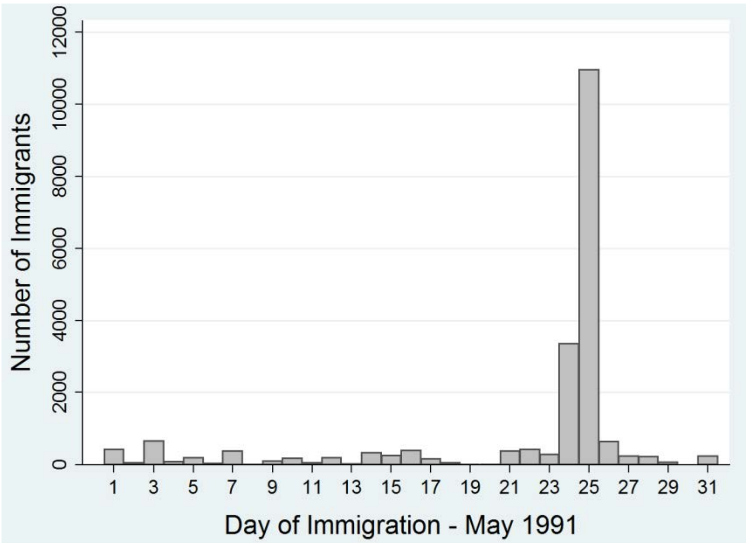
Figure 1. Immigration of Ethiopians Jews from Ethiopia to Israel during the years 1975 - 2010



Source: Israel Central Bureau of Statistics.

Figure 2. Immigration Flow of the Ethiopians Jews from Ethiopia to Israel during May 1991



Source: Israel Central Bureau of Statistics.

Figure 3. Definition of the three trimester groups

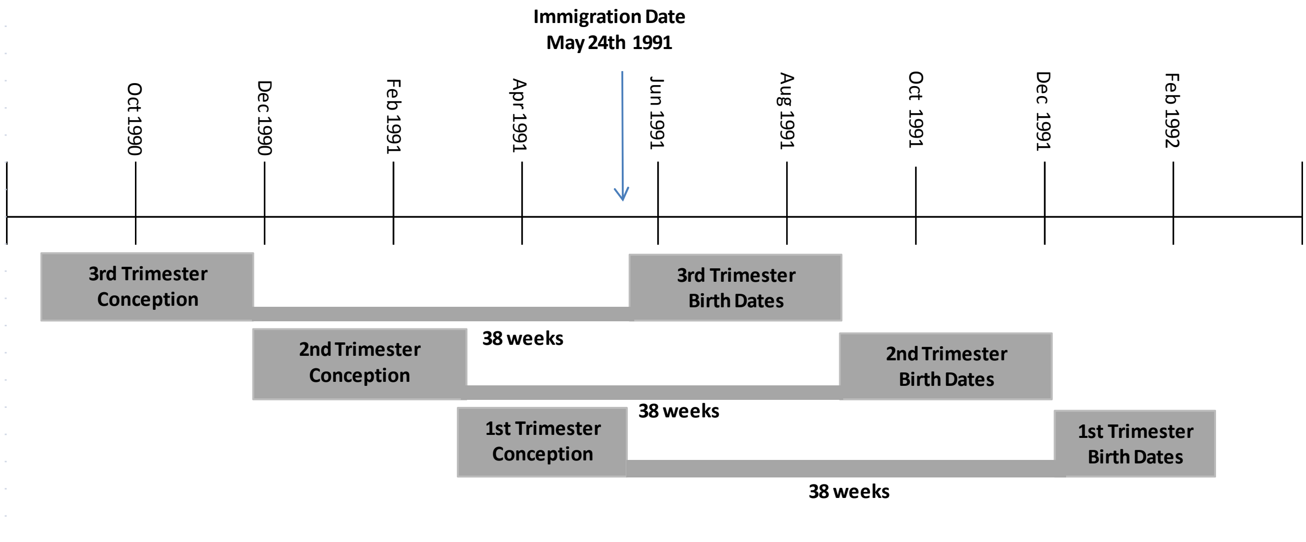


Figure 4. Birth Distribution of Main Sample and two comparison groups

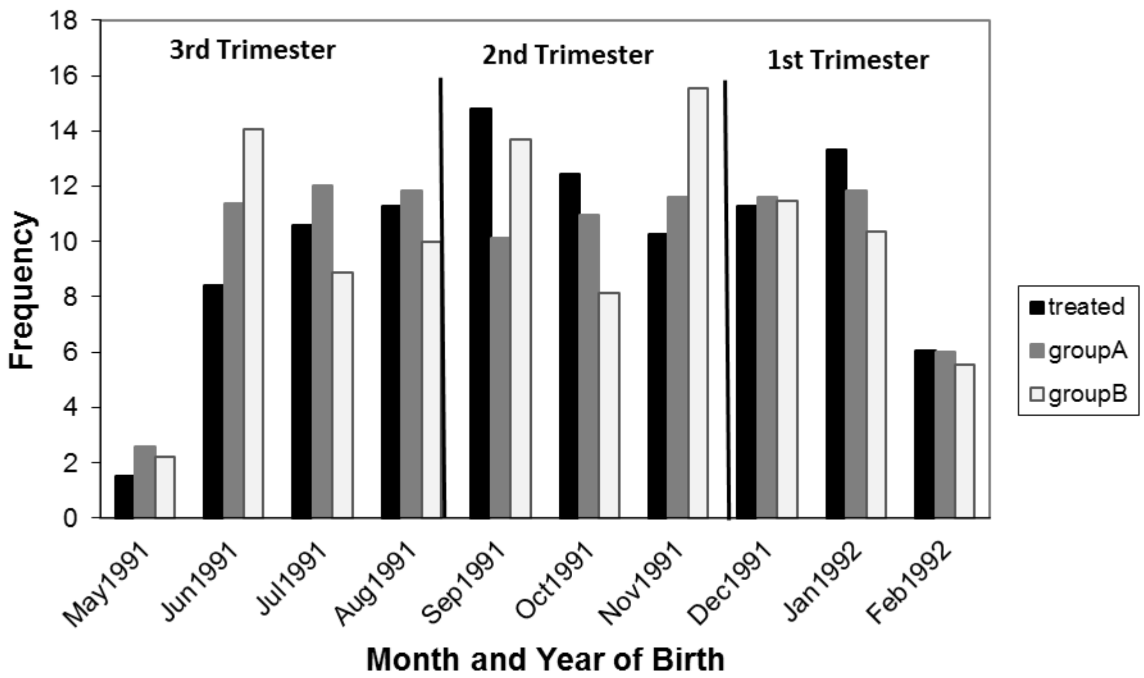


Figure 5. Share of births by gestational week on May 24 1991

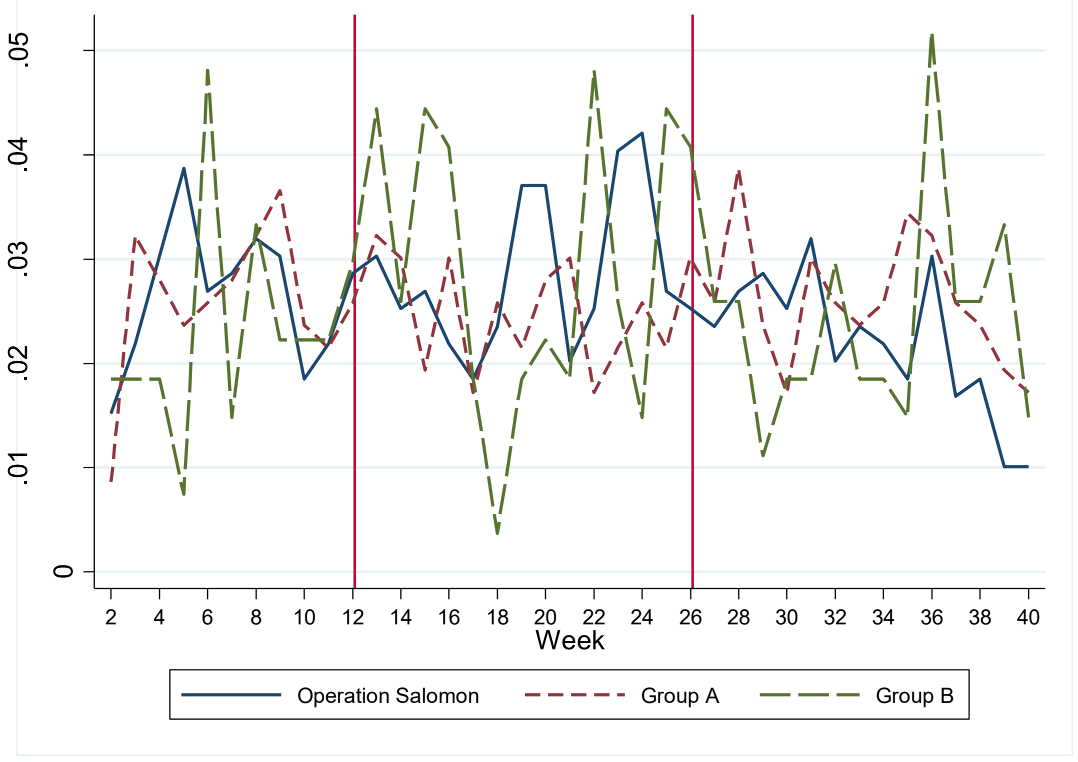


Table 1. Descriptive statistics

	Main Sample	Comparison Samples - Ethiopian Origin	
	"Operation Solomon" Children	Israeli Born Children (parents immigrated before 1989)	Ethiopian Born Children (parents immigrated after 1991)
	(1)	(2)	(3)
A. Background Characteristics			
Female	0.480	0.505	0.415
	(0.500)	(0.501)	(0.494)
Mother's age at birth	30.73	28.88	27.540
	(8.892)	(7.027)	(7.919)
Mother's age at first birth	23.10	21.37	21.05
	(5.426)	(4.239)	(5.122)
Parents age gap	10.90	6.957	9.493
	(7.315)	(5.777)	(6.256)
Number of siblings	5.345	4.391	4.933
	(1.928)	(1.891)	(1.691)
Birth order	3.682	3.415	3.322
	(2.200)	(1.910)	(1.925)
Birth-spacing (years to the next birth)	2.462	2.838	2.418
	(2.201)	(2.805)	(1.820)
Father's years of schooling	1.272	3.997	1.440
	(3.043)	(5.285)	(3.487)
Mother's years of schooling	1.412	3.789	1.192
	(3.240)	(5.000)	(3.070)
SES of the mother's first locality of	-0.039	-0.004	0.115
residence upon immigration	(0.546)	(0.556)	(0.473)
Family income in 1995 (NIS)	16,397	47,255	6,896
	(14274.3)	(33537.3)	(12238.9)
B. Outcomes			
Did not repeat 6-12th grade	0.806	0.824	0.800
	(0.395)	(0.382)	(0.401)
Did not drop out of high school	0.848	0.873	0.859
before completing 12th grade	(0.359)	(0.333)	(0.348)
Obtained a Baccalaureate diploma	0.305	0.351	0.319
	(0.461)	(0.478)	(0.467)
Total Baccalaureate units	11.58	12.85	11.98
	(11.14)	(10.84)	(11.12)
Math Baccalaureate units	1.276	1.465	1.289
(0 to 5)	(1.508)	(1.507)	(1.554)
English Baccalaureate units	1.978	2.374	1.944
(0 to 5)	(1.876)	(1.907)	(1.831)
Birth Weight (gr)	3068.2	3101.5	
	(480.2)	(566.7)	
Low birth weight (<2500gr)	0.110	0.111	
	(0.313)	(0.314)	
Very low birth weight (<1500gr)	0.005	0.017	
	(0.0715)	(0.131)	
Child Mortality	0.020	0.010	
	(0.140)	(0.103)	
Number of children	594	465	270

Notes: Standard deviations are presented in parenthesis. Children in all samples were born between 27th May 1991 and 15th February 1992.

Table 2. Summary Statistics for the Observable Characteristics broken down by Treatment Groups

	First Trimester (1)	Second Trimester (2)	Third Trimester (3)	Difference between First and Second (4)	Difference between First and Third (5)	Difference between Second and Third (6)	Difference by Week of Gestation (7)
Female	0.462	0.506	0.462	-0.044	0.001	0.045	-0.0004
	(0.500)	(0.501)	(0.500)	(0.050)	(0.053)	(0.049)	(0.0015)
Mother's age at birth	31.29	30.51	30.47	0.779	0.816	0.038	-0.036
	(9.616)	(8.464)	(8.748)	(0.895)	(0.975)	(0.845)	(0.035)
Mother's age at first birth	23.50	23.11	22.70	0.388	0.794	0.405	-0.036*
	(5.954)	(5.295)	(5.058)	(0.557)	(0.585)	(0.511)	(0.021)
Parents age gap	9.965	11.53	10.96	-1.562**	-0.991	0.571	0.024
	(6.305)	(8.188)	(6.928)	(0.744)	(0.704)	(0.755)	(0.023)
Number of siblings	5.422	5.301	5.330	0.121	0.092	-0.028	-0.001
	(2.021)	(1.829)	(1.972)	(0.191)	(0.212)	(0.186)	(0.009)
Birth order	3.653	3.640	3.764	0.013	-0.111	-0.124	0.004
	(2.222)	(2.159)	(2.243)	(0.218)	(0.237)	(0.216)	(0.010)
Birth-spacing (years to the next birth)	2.457	2.363	2.597	0.095	-0.139	-0.234	0.003
	(2.167)	(2.152)	(2.299)	(0.215)	(0.237)	(0.218)	(0.011)
Father's years of schooling	1.190	1.476	1.082	-0.286	0.108	0.395	-0.005
	(2.781)	(3.417)	(2.744)	(0.316)	(0.293)	(0.309)	(0.011)
Mother's years of schooling	1.173	1.744	1.203	-0.571*	-0.030	0.541	0.001
	(2.912)	(3.573)	(3.051)	(0.331)	(0.317)	(0.330)	(0.014)
SES of the mother's first locality of residence upon immigration	-0.091	-0.013	-0.023	-0.078	-0.068	0.010	0.003
	(0.549)	(0.598)	(0.465)	(0.058)	(0.054)	(0.054)	(0.002)
Family income in 1995 (NIS)	17335	15880	16184	1455	1151	-304	-25.461
	(14923)	(14298)	(13632)	(1453)	(1515)	(1378)	(60.338)
Median Week of Gestation on Arrival to Israel	5	18	31				
Number of days in trimester	73	97	93				
Number of boys	93	118	98				
Number of girls	80	121	84				
Number of children	173	239	182				594

Notes: Standard deviations are presented in parenthesis. In column 7 standard errors reported in parenthesis are clustered at week of pregnancy. First trimester includes children born between December 4th 1991 and February 15th 1992, second trimester includes children born between August 28th 1991 and December 3th 1991 and third trimester includes children born between May 27th 1991 and August 27th 1991.

Table 3. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 - Baseline Sample (OLS)

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
First Trimester	0.103***	0.118***	0.054	0.069*	0.134**	0.120**	3.620***	3.270***	0.469***	0.442***	0.566***	0.517***
	(0.036)	(0.038)	(0.038)	(0.039)	(0.054)	(0.052)	(1.090)	(1.047)	(0.150)	(0.153)	(0.177)	(0.170)
Second Trimester	0.059	0.057	0.035	0.033	0.073	0.063	2.328**	2.141**	0.292*	0.267	0.383**	0.348**
	(0.039)	(0.038)	(0.040)	(0.037)	(0.053)	(0.056)	(1.021)	(1.034)	(0.160)	(0.173)	(0.153)	(0.147)
p-value: First Trimester = Second Trimester	0.163	0.062	0.507	0.250	0.267	0.256	0.214	0.228	0.199	0.197	0.244	0.231
Number of children	594		594		594		594		594		594	

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy. Each column is from a different regression. Controls includes both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The Baseline sample includes the cohort born between May 27th 1991 and February 15th 1992. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table 4. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 - Two Cohorts Sample (DID)

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
First Trimester	0.090***	0.110***	0.051*	0.069**	0.070	0.077	2.273**	2.556***	0.382***	0.422***	0.242	0.287*
	(0.014)	(0.018)	(0.027)	(0.028)	(0.045)	(0.048)	(0.847)	(0.866)	(0.104)	(0.113)	(0.172)	(0.165)
Second Trimester	0.041	0.030	0.024	0.012	0.022	0.008	1.399*	1.096	0.202**	0.169	0.188	0.147
	(0.035)	(0.037)	(0.034)	(0.037)	(0.043)	(0.044)	(0.802)	(0.806)	(0.089)	(0.106)	(0.171)	(0.159)
p-value: First Trimester = Second Trimester	0.161	0.028	0.357	0.051	0.346	0.159	0.295	0.059	0.063	0.010	0.705	0.295
Number of children	2,389		2,389		2,389		2,389		2,389		2,389	

Notes: Standard errors reported in parenthesis are clustered at month and year of birth. Each column is from a different regression that includes cohort and month of birth fixed effects. Controls includes both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two years cohorts sample includes cohorts born between May 27th 1991 and February 15th 1992 and cohorts born between May 27th 1990 and February 15th 1991. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table 5. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 by Gender

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate 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)
A. Boys												
Mean of Dependent variable	0.738	0.728	0.786	0.780	0.214	0.221	9.052	8.971	1.042	1.020	1.553	1.572
First Trimester	0.061	0.038	0.039	0.046	0.067	-0.013	1.571	0.541	0.230	0.149	0.214	-0.107
	(0.072)	(0.045)	(0.063)	(0.051)	(0.053)	(0.062)	(1.303)	(0.963)	(0.193)	(0.152)	(0.211)	(0.123)
Second Trimester	-0.002	-0.019	0.001	-0.011	0.020	-0.054*	0.708	-0.162	0.166	0.120	0.033	-0.167
	(0.068)	(0.049)	(0.055)	(0.039)	(0.052)	(0.029)	(1.287)	(0.656)	(0.208)	(0.103)	(0.167)	(0.157)
p-value: First Trimester = Second Trimester	0.267	0.212	0.482	0.151	0.358	0.499	0.413	0.500	0.720	0.829	0.349	0.645
Number of children	309	1224	309	1224	309	1224	309	1224	309	1224	309	1224
B. Girls												
Mean of Dependent variable	0.881	0.895	0.916	0.931	0.404	0.421	14.32	15.12	1.530	1.677	2.439	2.575
First Trimester	0.183***	0.202***	0.097**	0.100**	0.175*	0.185**	5.062***	5.049***	0.680***	0.765***	0.821***	0.778**
	(0.043)	(0.027)	(0.041)	(0.044)	(0.089)	(0.087)	(1.683)	(1.358)	(0.241)	(0.223)	(0.278)	(0.281)
Second Trimester	0.113**	0.086**	0.050	0.032	0.120	0.077	3.786**	2.710*	0.427*	0.256	0.688***	0.535*
	(0.045)	(0.035)	(0.043)	(0.048)	(0.095)	(0.089)	(1.591)	(1.443)	(0.236)	(0.218)	(0.231)	(0.279)
p-value: First Trimester = Second Trimester	0.045	0.007	0.206	0.170	0.457	0.168	0.392	0.066	0.218	0.007	0.593	0.235
Number of children	285	1165	285	1165	285	1165	285	1165	285	1165	285	1165
C. P-value for difference in the coefficient between boys and girls												
First Trimester	0.180	0.022	0.431	0.490	0.279	0.113	0.083	0.010	0.143	0.065	0.072	0.007
Second trimester	0.176	0.040	0.447	0.418	0.324	0.210	0.121	0.090	0.352	0.625	0.024	0.047

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from different regression. Panel A reports estimates for boys and panel B reports estimates for girls. Panel C reports p-values from F-tests that check the difference between coefficients of boys and girls. All specifications controls for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline sample includes children born between May 27th 1991 and February 15th 1992 and the two cohorts sample includes children born between May 27th 1991 and February 15th 1992 and children born between May 27th 1990 and February 15th 1991. The baseline category is the third trimester of pregnancy.
*Significant at 10%; **significant at 5%; ***significant at 1%

Table 6. Estimated Effect of in-Utero Environment among FSU Immigrants

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls	No Controls	With Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Mean of dependent variable	0.885		0.704		0.368		20.14		2.538		3.363	
First Trimester	0.003	0.002	0.004	0.004	0.011	0.016	0.126	0.270	0.049	0.078	0.011	0.038
	(0.023)	(0.023)	(0.018)	(0.017)	(0.026)	(0.025)	(0.665)	(0.626)	(0.105)	(0.100)	(0.110)	(0.103)
Second Trimester	0.043*	0.044*	0.009	0.009	-0.002	-0.004	0.244	0.157	0.039	0.025	0.163	0.150
	(0.022)	(0.023)	(0.017)	(0.017)	(0.026)	(0.025)	(0.656)	(0.618)	(0.104)	(0.098)	(0.109)	(0.102)
Number of children	2,039	2,039	2,039	2,039	2,039	2,039	2,039	2,039	2,039	2,039	2,039	2,039

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy. Each column is from a different regression. Controls includes both parents' years of schooling, gender dummy, number of siblings, year and month of birth fixed effects. The baseline category is the third trimester of pregnancy.
*Significant at 10%; **significant at 5%; ***significant at 1%

Table 7. Estimated Effect of in-Utero Environment among FSU Immigrants by Gender

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
First Trimester	-0.015	0.024	0.014	-0.004	0.008	0.022	0.679	-0.177	0.048	0.092	0.097	-0.027
	(0.035)	(0.030)	(0.029)	(0.020)	(0.036)	(0.035)	(0.972)	(0.806)	(0.150)	(0.133)	(0.160)	(0.133)
Second Trimester	0.053	0.035	0.020	-0.003	0.023	-0.024	0.943	-0.529	0.059	0.011	0.272*	0.051
	(0.034)	(0.030)	(0.028)	(0.020)	(0.035)	(0.035)	(0.943)	(0.808)	(0.145)	(0.134)	(0.156)	(0.133)
Number of children	1,012	1,027	1,012	1,027	1,012	1,027	1,012	1,027	1,012	1,027	1,012	1,027

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy. Each Colum is from a different regression. Controls includes both parents' years of schooling, number of siblings, year and month of birth fixed effects. The baseline category is the third trimester of pregnancy. Odd columns report estimates for boys and even columns report estimates for girls.
*Significant at 10%; **significant at 5%; ***significant at 1%

Table 8. Estimated Effect of In-Utero Environment on Birth Weight

	Birth weight (in grams)				Low birth weight (<2500 gr)			
	Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)		Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)	
	No Controls (1)	With Controls (2)	No Controls (3)	With Controls (4)	No Controls (5)	With Controls (6)	No Controls (7)	With Controls (8)
Mean of Dependent Variable	3,068		3,082		0.110		0.110	
First Trimester	58.252	95.764**	36.840	41.377	0.022	-0.015	0.053	0.044
	(63.469)	(46.184)	(74.573)	(60.444)	(0.039)	(0.032)	(0.048)	(0.035)
Second Trimester	101.398	102.006**	75.143	55.335	-0.024	-0.029	-0.036	-0.027
	(62.472)	(50.008)	(83.742)	(70.861)	(0.038)	(0.027)	(0.045)	(0.037)
p-value: First Trimester = Second Trimester	0.394	0.858	0.684	0.836	0.183	0.566	0.069	0.018
Number of children	584		1,045		584		1,045	

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The baseline sample (reported in columns 1, 2, 5, and 6) includes cohorts born between May 27th 1991 and February 15th 1992. The sample reported in columns 3, 4, 7, and 8 includes also children from Ethiopian origin born in Israel during the same period whose parents immigrated before 1989. The model for this extended sample controls also for month of birth fixed effects and includes dummy for 2nd generation "Operation Moses". The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table 9. Estimated Effect of In-Utero Environment on Mortality before Age 12

	All				Boys				Girls			
	Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)		Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)		Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)	
	No controls (1)	With controls (2)	No controls (3)	With controls (4)	No controls (5)	With controls (6)	No controls (7)	With controls (8)	No controls (9)	With controls (10)	No controls (11)	With controls (12)
Mean of Dependent Variable	0.020		0.016		0.023		0.020		0.018		0.012	
First Trimester	-0.032*	-0.046***	-0.036	-0.041**	-0.040	-0.059**	-0.056	-0.082***	-0.023	-0.030	-0.013	-0.005
	(0.018)	(0.017)	(0.024)	(0.019)	(0.025)	(0.028)	(0.035)	(0.030)	(0.029)	(0.019)	(0.031)	(0.021)
Second Trimester	-0.036**	-0.030**	-0.033	-0.025	-0.043*	-0.042*	-0.044	-0.050*	-0.027	-0.016	-0.018	-0.005
	(0.018)	(0.014)	(0.022)	(0.018)	(0.025)	(0.024)	(0.029)	(0.025)	(0.027)	(0.015)	(0.029)	(0.022)
p-value: First Trimester = Second Trimester	0.727	0.178	0.828	0.227	0.862	0.242	0.616	0.136	0.708	0.350	0.708	0.972
Number of children	594	594	1059	1059	309	309	539	539	285	285	520	520
<u>P-value for difference in the coefficient between boys and girls:</u>												
First Trimester	0.352	0.141	0.141	0.014								
Second Trimester	0.331	0.195	0.195	0.055								

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The baseline sample (reported in columns 1, 2, 5, 6, 9 and 10) includes cohorts born between May 27th 1991 and February 15th 1992. The sample reported in columns 3, 4, 7, 8, 11 and 12 includes also children from Ethiopian origin born in Israel during the same period whose parents immigrated before 1989. The model for this extended sample controls also for month of birth fixed effects and includes dummy for 2nd generation "Operation Moses". The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table 10. Potential Longer Term Returns

	All			Males			Females		
	Post-secondary education enrollment rate	University enrollment rate	Monthly income (2012)	Post-secondary education enrollment rate	University enrollment rate	Monthly income (2012)	Post-secondary education enrollment rate	University enrollment rate	Monthly income (2012)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean of Dependent variable	0.632	0.056	4,838	0.622	0.026	5,367	0.642	0.087	4,283
Baccalaureate Diploma	0.263***	0.114***	578.09***	0.264***	0.040**	306.0	0.261***	0.181***	810.23**
	(0.025)	(0.018)	(177.45)	(0.037)	(0.018)	(300.7)	(0.033)	(0.027)	(234.12)
Baccalaureate Units	0.014***	0.003***	36.577***	0.012***	0.001*	31.60***	0.017***	0.006***	42.258***
	(0.001)	(0.001)	(7.923)	(0.001)	(0.001)	(11.918)	(0.002)	(0.001)	(9.136)
Number of Advanced Subjects	0.117***	0.047***	230.80***	0.104***	0.020**	-4.618	0.127***	0.074***	446.87***
	(0.009)	(0.008)	(78.242)	(0.013)	(0.009)	(125.87)	(0.013)	(0.011)	90.514
Units in Advanced Science Subjects	0.042***	0.028***	132.45	0.050***	0.017*	-110.19	0.037***	0.036***	285.94***
	(0.006)	(0.008)	(83.724)	(0.009)	(0.009)	(129.15)	(0.006)	(0.011)	(95.387)
Number of observations	1,329	1,329	1,329	680	680	680	649	649	649

Notes: Standard errors clustered at month and year of birth are reported in parenthesis. Each column is from different regression that includes year of birth fixed effects. All specifications controls also for both parents' years of schooling and number of siblings. Models in columns 1-3 controls also for gender.

*Significant at 10%; **significant at 5%; ***significant at 1%

ONLINE APPENDIX

Table A1. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 by Weeks of Exposure to the Israeli Environment

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	Baseline Sample (OLS) (1)	Two Cohorts Sample (DID) (2)	Baseline Sample (OLS) (3)	Two Cohorts Sample (DID) (4)	Baseline Sample (OLS) (5)	Two Cohorts Sample (DID) (6)	Baseline Sample (OLS) (7)	Two Cohorts Sample (DID) (8)	Baseline Sample (OLS) (9)	Two Cohorts Sample (DID) (10)	Baseline Sample (OLS) (11)	Two Cohorts Sample (DID) (12)
Week	-0.004***	-0.004***	-0.0026*	-0.0029***	-0.0035*	-0.0022	-0.0976**	-0.0741**	-0.0146***	-0.0137***	-0.0152**	-0.0078
	(0.001)	(0.001)	(0.0014)	(0.0008)	(0.0018)	(0.0019)	(0.0374)	(0.0335)	(0.0053)	(0.0040)	(0.0067)	(0.0071)
Number of children	594	2389	594	2389	594	2389	594	2389	594	2389	594	2389

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline sample includes children born between May 27th 1991 and February 15th 1992. The two years sample includes children born between May 27th 1991 and February 15th 1992 and children born between May 27th 1990 and February 15th 1991. The main explanatory variable is week of gestation upon immigration to Israel (ranging from 2 to 40).

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A2. Balancing Tests for the FSU Sample

	Father's years of schooling (1)	Mother's years of schooling (2)	Number of siblings (3)	Boy (4)
Mean dependent variable	10.61	11.61	0.885	0.496
	(5.933)	(5.086)	(0.950)	(0.500)
First Trimester	-0.386	-0.416	-0.051	-0.033
	(0.318)	(0.273)	(0.051)	(0.027)
Second Trimester	-0.036	-0.014	0.056	-0.018
	(0.317)	(0.272)	(0.051)	(0.027)
Number of children	2,039	2,039	2,039	2,039

Notes: The table reports differences in covariates between children born in the first or second trimester and children born in the third trimester. Standard errors clustered at month and year of birth are reported in parenthesis. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A3. Estimated Effect of In-Utero Environment on Birth Weight by Gender

	Birth weight (in grams)				Low birth weight (<2500 gr)			
	Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)		Baseline Sample (OLS)		Baseline Sample + 2nd generation - "Operation Moses" (DID)	
	No Controls (1)	With Controls (2)	No Controls (3)	With Controls (4)	No Controls (5)	With Controls (6)	No Controls (7)	With Controls (8)
A. Boys								
Mean of Dependent variable	3,106		3,112		0.109		0.117	
First Trimester	42.514	85.272	9.936	30.051	-0.002	-0.054	0.031	0.009
	(91.565)	(73.234)	(109.826)	(105.843)	(0.063)	(0.049)	(0.065)	(0.052)
Second Trimester	168.467*	174.916**	222.399**	195.472**	-0.064	-0.075*	-0.092	-0.075
	(91.447)	(73.887)	(95.143)	(86.860)	(0.061)	(0.043)	(0.062)	(0.055)
Number of children	303		531		303		531	
B. Girls								
Mean of Dependent variable	3,026		3,051		0.110		0.103	
First Trimester	77.625	93.259	56.129	37.159	0.050	0.030	0.103*	0.096*
	(62.655)	(72.517)	(89.307)	(92.840)	(0.049)	(0.049)	(0.058)	(0.057)
Second Trimester	42.799	32.064	-87.407	-114.295	0.020	0.017	0.050	0.052
	(59.989)	(60.533)	(96.132)	(92.566)	(0.041)	(0.042)	(0.045)	(0.049)
Number of children	281		514		281		514	
C. P-value for difference in the coefficient between boys and girls								
First Trimester	0.967	0.651	0.830	0.924	0.700	0.251	0.621	0.276
Second trimester	0.104	0.035	0.006	0.029	0.262	0.109	0.086	0.140

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. Panel A reports estimates for boys and panel B reports estimates for girls. Panel C reports p-values from F-tests that check the difference between coefficients of boys and girls. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The baseline sample (reported in columns 1, 2, 5, and 6) includes cohorts born between May 27th 1991 and February 15th 1992. The sample reported in columns 3, 4, 7, and 8 includes also children from Ethiopian origin born in Israel during the same period whose parents immigrated before 1989. The model for this extended sample controls also for month of birth fixed effects and includes dummy for 2nd generation "Operation Moses". The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A4. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 by Gender Excluding Children who Died

	Did not repeat 6-12th grade		Did not drop out before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	Baseline Sample (OLS) (1)	Two Cohorts Sample (DID) (2)	Baseline Sample (OLS) (3)	Two Cohorts Sample (DID) (4)	Baseline Sample (OLS) (5)	Two Cohorts Sample (DID) (6)	Baseline Sample (OLS) (7)	Two Cohorts Sample (DID) (8)	Baseline Sample (OLS) (9)	Two Cohorts Sample (DID) (10)	Baseline Sample (OLS) (11)	Two Cohorts Sample (DID) (12)
A. Boys												
Mean of Dependent variable	0.755	0.739	0.805	0.793	0.219	0.224	9.262	9.113	1.066	1.036	1.589	1.597
First Trimester	0.009	-0.008	-0.015	-0.002	0.045	-0.036	0.705	-0.305	0.149	0.066	0.081	-0.248*
	(0.065)	(0.035)	(0.055)	(0.040)	(0.051)	(0.055)	(1.231)	(0.871)	(0.198)	(0.144)	(0.209)	(0.129)
Second Trimester	-0.040	-0.046	-0.038	-0.039	0.003	-0.068**	0.050	-0.659	0.106	0.072	-0.067	-0.249
	(0.063)	(0.041)	(0.049)	(0.031)	(0.051)	(0.028)	(1.214)	(0.711)	(0.209)	(0.108)	(0.158)	(0.168)
p-value: First Trimester = Second Trimester	0.382	0.331	0.651	0.254	0.405	0.580	0.553	0.718	0.817	0.958	0.461	0.998
Number of children	302	1205	302	1205	302	1205	302	1205	302	1205	302	1205
B. Girls												
Mean of Dependent variable	0.896	0.901	0.932	0.938	0.411	0.424	14.57	15.23	1.557	1.689	2.482	2.593
First Trimester	0.156***	0.181***	0.067	0.078*	0.168*	0.182**	4.595**	4.785***	0.648**	0.753***	0.741**	0.729**
	(0.046)	(0.023)	(0.041)	(0.038)	(0.092)	(0.086)	(1.708)	(1.242)	(0.250)	(0.214)	(0.284)	(0.257)
Second Trimester	0.098**	0.073**	0.035	0.018	0.114	0.073	3.527**	2.532*	0.399*	0.242	0.649***	0.504*
	(0.046)	(0.028)	(0.042)	(0.041)	(0.096)	(0.086)	(1.560)	(1.287)	(0.237)	(0.204)	(0.228)	(0.250)
p-value: First Trimester = Second Trimester	0.078	0.006	0.353	0.189	0.480	0.175	0.485	0.081	0.248	0.008	0.712	0.284
Number of children	280	1157	280	1157	280	1157	280	1157	280	1157	280	1157
C. P-value for difference in the coefficient between boys and girls												
First Trimester	0.365	0.028	0.444	0.387	0.555	0.114	0.268	0.011	0.466	0.148	0.228	0.001
Second trimester	0.212	0.032	0.305	0.103	0.405	0.079	0.230	0.055	0.675	0.781	0.055	0.025

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from different regression. Panel A reports estimates for boys and panel B reports estimates for girls. Panel C reports p-values from F-tests that check the difference between coefficients of boys and girls. All specifications controls for both parents' years of schooling, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline sample includes children born between May 27th 1991 and February 15th 1992 and the two cohorts sample includes children born between May 27th 1991 and February 15th 1992 and children born between May 27th 1990 and February 15th 1991. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A5. Estimated Effect of Mothers' Length of Stay in Israel before the Birth on Schooling Outcomes

	Did not repeat 6-12th grade (1)	Did not drop out before completing 12th grade (2)	Obtained a Baccalaureate diploma (3)	Total Baccalaureate units (4)	Math Baccalaureate units (5)	English Baccalaureate units (6)	Birth Weight (7)
				A. All			
Weeks in Israel	-0.0003	-0.0004	-0.0001	-0.0106	-0.0003	-0.0011	-0.3214
	(0.0004)	(0.0005)	(0.0005)	(0.0139)	(0.0021)	(0.0021)	(0.5443)
Number of children	980	980	980	980	980	980	965
				B. Boys			
Weeks in Israel	0.0002	0.0002	0.0005	0.0092	0.0024	-0.0005	-1.1908*
	(0.0006)	(0.0007)	(0.0006)	(0.0170)	(0.0028)	(0.0030)	(0.6767)
Number of children	495	495	495	495	495	495	488
				C. Girls			
Weeks in Israel	-0.0009*	-0.0010**	0.0003	-0.0214	-0.0022	-0.0010	0.4828
	(0.0004)	(0.0005)	(0.0006)	(0.0162)	(0.0024)	(0.0025)	(0.8218)
Number of children	485	485	485	485	485	485	477

Notes: Standard errors reported in parenthesis are clustered at month and year of birth. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The sample includes children born between March 1992 and October 1994. The main explanatory variable is the number of weeks since the mother immigrated to Israel (ranging from 43 to 127) when the child was born.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A6. Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 - Splitting the First Trimester into Three Months

	Did not repeat 6-12th grade		Did not drop out of high school before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate units	
	No Controls (1)	With Controls (2)	No Controls (3)	With Controls (4)	No Controls (5)	With Controls (6)	No Controls (7)	With Controls (8)	No Controls (9)	With Controls (10)	No Controls (11)	With Controls (12)
A. The Baseline Sample (OLS)												
First Month	0.063	0.088	-0.002	0.033	0.032	0.227***	4.733***	3.253*	0.623***	0.525**	0.661***	0.514*
	(0.038)	(0.057)	(0.039)	(0.059)	(0.068)	(0.039)	(1.252)	(1.624)	(0.182)	(0.214)	(0.158)	(0.256)
Second Month	0.105**	0.113**	0.054	0.062	0.123***	0.126***	3.803***	3.863***	0.537***	0.548***	0.677***	0.676***
	(0.043)	(0.045)	(0.047)	(0.046)	(0.032)	(0.041)	(1.076)	(1.038)	(0.133)	(0.138)	(0.218)	(0.189)
Third Month	0.126**	0.142***	0.093**	0.101***	0.122**	0.079	2.603	2.517	0.275	0.253	0.356	0.313
	(0.048)	(0.043)	(0.042)	(0.037)	(0.046)	(0.101)	(1.729)	(1.656)	(0.194)	(0.196)	(0.238)	(0.225)
Second Trimester	0.053	0.057	0.029	0.033	0.032	0.065	2.097**	2.144**	0.271	0.268	0.344**	0.349**
	(0.038)	(0.038)	(0.038)	(0.037)	(0.049)	(0.053)	(1.010)	(1.036)	(0.161)	(0.173)	(0.150)	(0.148)
Number of students	594		594		594		594		594		594	
B. Two Cohorts Sample (DID)												
First Month	0.072***	0.114***	0.009	0.061	0.169***	0.174***	3.784***	3.491***	0.512***	0.553***	0.387	0.367
	(0.021)	(0.035)	(0.029)	(0.042)	(0.048)	(0.046)	(0.943)	(1.005)	(0.081)	(0.109)	(0.258)	(0.267)
Second Month	0.104***	0.118***	0.055*	0.067**	0.077**	0.086**	2.549**	2.999**	0.501***	0.541***	0.434**	0.503***
	(0.016)	(0.017)	(0.027)	(0.025)	(0.028)	(0.032)	(1.059)	(1.075)	(0.112)	(0.121)	(0.154)	(0.149)
Third Month	0.095***	0.098***	0.084***	0.078**	0.011	0.006	1.370**	1.444**	0.199***	0.199**	-0.014	-0.019
	(0.017)	(0.020)	(0.028)	(0.030)	(0.031)	(0.032)	(0.559)	(0.541)	(0.069)	(0.073)	(0.131)	(0.130)
Second Trimester	0.034	0.029	0.018	0.012	0.014	0.007	1.151	1.085	0.174*	0.167	0.146	0.144
	(0.034)	(0.037)	(0.034)	(0.037)	(0.042)	(0.045)	(0.789)	(0.809)	(0.090)	(0.107)	(0.161)	(0.160)
Number of children	2,389		2,389		2,389		2,389		2,389		2,389	

Notes: Standard errors presented in parenthesis are clustered at week of pregnancy for the OLS regressions and at year and month of birth for the DID regressions. Each column is from a different regression. Controls includes both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order, and dummy for twins. The two cohorts sample (reported in Panel B) includes controls also for cohort and month of birth fixed effects. The Baseline sample includes children born between May 27th 1991 and February 15th 1992. The two cohorts sample includes children born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A7. Estimated Effect of In-Utero Environment on Schooling Outcomes - Excluding First Two Weeks from each Trimester

	Did not repeat 6-12th grade		Did not drop out of high school before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate 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: Excluding first 2 weeks of 1st trimester												
First Trimester	0.127***	0.117***	0.080**	0.079**	0.108*	0.065	3.252***	2.480**	0.460***	0.442***	0.500***	0.269
	(0.039)	(0.022)	(0.039)	(0.031)	(0.054)	(0.045)	(1.064)	(0.909)	(0.158)	(0.132)	(0.173)	(0.171)
Second Trimester	0.054	0.027	0.030	0.009	0.063	0.005	2.114**	1.036	0.267	0.164	0.343**	0.138
	(0.038)	(0.037)	(0.037)	(0.036)	(0.056)	(0.045)	(1.034)	(0.802)	(0.174)	(0.105)	(0.147)	(0.159)
Number of students	569	2364	569	2364	569	2364	569	2364	569	2364	569	2364
Panel B: Excluding first 2 weeks of 2nd trimester												
First Trimester	0.120***	0.111***	0.071*	0.071**	0.120**	0.078	3.285***	2.546**	0.441***	0.421***	0.523***	0.284
	(0.038)	(0.019)	(0.039)	(0.028)	(0.052)	(0.050)	(1.054)	(0.926)	(0.154)	(0.120)	(0.170)	(0.176)
Second Trimester	0.055	0.035	0.031	0.012	0.066	0.010	2.296**	1.319	0.263	0.175	0.341**	0.154
	(0.041)	(0.041)	(0.039)	(0.039)	(0.059)	(0.049)	(1.056)	(0.788)	(0.180)	(0.112)	(0.152)	(0.156)
Number of students	560	2355	560	2355	560	2355	560	2355	560	2355	560	2355
Panel C: Excluding first 2 weeks of 3rd trimester												
First Trimester	0.125***	0.115***	0.090**	0.093***	0.133**	0.096*	3.803***	3.178***	0.523***	0.502***	0.534***	0.331*
	(0.042)	(0.017)	(0.038)	(0.017)	(0.058)	(0.048)	(1.034)	(0.849)	(0.150)	(0.106)	(0.188)	(0.183)
Second Trimester	0.065	0.035	0.053	0.036	0.082	0.028	2.776***	1.749**	0.365**	0.255**	0.379**	0.194
	(0.042)	(0.037)	(0.036)	(0.029)	(0.062)	(0.043)	(1.007)	(0.768)	(0.169)	(0.089)	(0.167)	(0.177)
Number of students	563	2358	563	2358	563	2358	563	2358	563	2358	563	2358
Panel D: Excluding first 2 weeks of all trimesters												
First Trimester	0.132***	0.120***	0.100**	0.101***	0.117*	0.082*	3.714***	3.019***	0.531***	0.513***	0.512**	0.299
	(0.042)	(0.022)	(0.039)	(0.022)	(0.060)	(0.046)	(1.057)	(0.944)	(0.159)	(0.134)	(0.190)	(0.197)
Second Trimester	0.059	0.039	0.048	0.035	0.085	0.030	2.913***	1.959**	0.365**	0.260**	0.372**	0.201
	(0.044)	(0.040)	(0.038)	(0.031)	(0.065)	(0.049)	(1.047)	(0.755)	(0.179)	(0.098)	(0.172)	(0.175)
Number of students	504	2299	504	2299	504	2299	504	2299	504	2299	504	2299

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A8. Estimated Effect of In-Utero Environment on Schooling Outcomes - Excluding Last Two Weeks from each Trimester

	Did not repeat 6-12th grade		Did not drop out of high school before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate 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: Excluding last 2 weeks of 1st trimester												
First Trimester	0.108***	0.102***	0.056	0.058**	0.115**	0.069	3.140**	2.377**	0.468***	0.442***	0.499**	0.270
	(0.039)	(0.021)	(0.041)	(0.027)	(0.054)	(0.058)	(1.164)	(1.050)	(0.164)	(0.120)	(0.190)	(0.200)
Second Trimester	0.059	0.031	0.036	0.013	0.065	0.009	2.199**	1.122	0.268	0.170	0.357**	0.151
	(0.039)	(0.037)	(0.037)	(0.037)	(0.056)	(0.044)	(1.046)	(0.797)	(0.174)	(0.106)	(0.149)	(0.158)
Number of students	565	2360	565	2360	565	2360	565	2360	565	2360	565	2360
Panel B: Excluding last 2 weeks of 2nd trimester												
First Trimester	0.119***	0.110***	0.068*	0.069**	0.122**	0.078	3.322***	2.554***	0.448***	0.425***	0.526***	0.285
	(0.039)	(0.018)	(0.039)	(0.028)	(0.052)	(0.048)	(1.043)	(0.875)	(0.153)	(0.113)	(0.167)	(0.166)
Second Trimester	0.068*	0.041	0.045	0.023	0.066	0.010	2.310**	1.175	0.296	0.191*	0.358**	0.138
	(0.039)	(0.034)	(0.038)	(0.034)	(0.059)	(0.047)	(1.075)	(0.846)	(0.179)	(0.105)	(0.152)	(0.162)
Number of students	564	2359	564	2359	564	2359	564	2359	564	2359	564	2359
Panel C: Excluding last 2 weeks of 3rd trimester												
First Trimester	0.118***	0.110***	0.065	0.063**	0.126**	0.081	3.508***	2.801***	0.489***	0.474***	0.565***	0.324*
	(0.040)	(0.020)	(0.040)	(0.029)	(0.053)	(0.048)	(1.069)	(0.872)	(0.154)	(0.115)	(0.170)	(0.160)
Second Trimester	0.060	0.031	0.031	0.006	0.071	0.012	2.417**	1.352	0.324*	0.224*	0.404***	0.187
	(0.040)	(0.038)	(0.039)	(0.038)	(0.057)	(0.045)	(1.051)	(0.816)	(0.174)	(0.110)	(0.147)	(0.153)
Number of students	583	2378	583	2378	583	2378	583	2378	583	2378	583	2378
Panel D: Excluding last 2 weeks of all trimesters												
First Trimester	0.111**	0.103***	0.052	0.051*	0.122**	0.073	3.407***	2.617**	0.516***	0.496***	0.552***	0.305
	(0.041)	(0.023)	(0.042)	(0.028)	(0.056)	(0.059)	(1.182)	(1.065)	(0.166)	(0.121)	(0.188)	(0.196)
Second Trimester	0.074*	0.043	0.046	0.019	0.076	0.016	2.658**	1.468*	0.357*	0.249**	0.428***	0.183
	(0.041)	(0.035)	(0.039)	(0.035)	(0.060)	(0.048)	(1.103)	(0.844)	(0.181)	(0.106)	(0.153)	(0.156)
Number of students	524	2319	524	2319	524	2319	524	2319	524	2319	524	2319

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%

Table A9. Estimated Effect of In-Utero Environment on Schooling Outcomes - Re-assign the First or Last Two Weeks of each Trimester to the Previous or Next Trimester

	Did not repeat 6-12th grade		Did not drop out of high school before completing 12th grade		Obtained a Baccalaureate diploma		Total Baccalaureate units		Math Baccalaureate units		English Baccalaureate 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: Re-assign the first two weeks to the previous trimester												
First Trimester	0.117***	0.093***	0.089**	0.086***	0.108*	0.068	3.295***	2.540**	0.495***	0.463***	0.484**	0.280
	(0.041)	(0.022)	(0.036)	(0.018)	(0.056)	(0.042)	(1.035)	(0.897)	(0.151)	(0.130)	(0.181)	(0.207)
Second Trimester	0.061	0.039	0.057	0.053*	0.090	0.047	3.010***	2.324***	0.388**	0.307***	0.346**	0.218
	(0.041)	(0.036)	(0.037)	(0.028)	(0.061)	(0.046)	(0.979)	(0.802)	(0.171)	(0.099)	(0.166)	(0.167)
Number of students	569	2382	569	2382	569	2382	569	2382	569	2382	569	2382
Panel B: Re-assign the last two weeks to the next trimester												
First Trimester	0.106***	0.101***	0.060	0.061**	0.104**	0.071	2.889**	2.302**	0.450***	0.446***	0.447**	0.249
	(0.038)	(0.022)	(0.038)	(0.026)	(0.051)	(0.061)	(1.105)	(1.099)	(0.152)	(0.121)	(0.183)	(0.202)
Second Trimester	0.078**	0.064**	0.059*	0.049*	0.068	0.024	2.274**	1.415**	0.275*	0.202**	0.328**	0.136
	(0.036)	(0.023)	(0.034)	(0.026)	(0.054)	(0.039)	(0.954)	(0.632)	(0.157)	(0.081)	(0.138)	(0.122)
Number of students	594	2407	594	2407	594	2407	594	2407	594	2407	594	2407

Notes: Standard errors reported in parenthesis are clustered at week of pregnancy for the OLS regressions and at month and year of birth for the DID regressions. Each column is from a different regression. All specifications controls for both parents' years of schooling, gender dummy, mother's age at birth, parents' age gap, SES of first locality in Israel, birth order and dummy for twins. The two cohorts sample (reported in columns 2, 4, 6, 8, 10 and 12) includes controls also for cohort and month of birth fixed effects. The baseline category is the third trimester of pregnancy.

*Significant at 10%; **significant at 5%; ***significant at 1%