Out of Africa: Human Capital Consequences of In Utero Conditions

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Abstract

This paper investigates the effects of micronutrient supplements and environmental conditions during pregnancy on later life outcomes using quasi-experimental variation created by the immigration of Ethiopian Jews to Israel in the early 90's. Over the course of 36 hours (beginning on May 24th 1991) 14,400 Jews were airlifted from Ethiopia to Israel. This immigration wave happened abruptly and was unexpected and therefore its timing is unlikely to be correlated with timing of pregnancy and birth of immigrant families. 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 micronutrient supplement. While in Ethiopia pregnant women were at high risk to suffer from iodine and iron deficiencies, in Israel pregnant women received vitamins (mainly Iron and Folic acid) and were exposed to an adequate iodine level. We exploit this natural experiment to study how variation in micronutrient supplements and environmental conditions during pregnancy experienced by women who gave birth shortly after arrival to Israel affected the long term educational outcomes of their children. Using administrative data from the whole population of Ethiopian immigrants we analyze the effects of trimester of exposure in utero to micronutrient supplements in Israel on the academic achievements of children by the end of high school at age 18. We focus only on children whom their pregnancy incepted in Ethiopia and were born in Israel. Therefore 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. We find that children exposed in earlier stage of the pregnancy to better environmental conditions in utero and micronutrient supplements have a higher likelihood of completing high school, obtaining a matriculation diploma and have a higher quality matriculation diploma. These effects are very large and robust to controls for seasonality and cohorts effects. However, no effect was found on birth weight.

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 and influence health, cognitive and non-cognitive outcomes later in life has meaningful implications for individual and policy decisions. However it is a tough 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 a review by Almond and Currie, 2011). Most of these studies use changes in the local environment caused by negative environmental shocks as exogenous variation in fetal health or in utero environmental conditions. Examples include historical events with well-defined start and end points such as the 1918 Influenza Pandemic (Almond 2006), the 1986 Chernobyl accident (Almond, Edlund and Palme, 2009), the 19th century blight in French vineyards (Banerjee, Duflo, Postel-Vinay, and Watts, 2010) and the 1959-1961 China Famine (Almond, Edlund, Li, and Zhang, 2007). Other examples are the use of variation in infectious disease (Barreca 2010) or economic shocks around the time of birth (Baten, Crayen, and Voth, 2007). There are also a few recent studies that analyze positive and policy driven events like increasing family resources (Hoynes, Schanzenbach and Almond, 2012) and immigration (Van Den Berg et al, 2012). However, these studies focus mainly on the effects of these events on later life health outcomes.

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 no vitamins consumption during pregnancy, in Israel pregnant women received vitamins (mainly Iron and Folic acid) and the iodine level is adequate. It is well established that micronutrient supplements during pregnancy, especially iron, folic acid and iodine, are essential for normal fetal development, including brain development. Previews studies, in medical and economics literature, investigated the effect of malnutrition during pregnancy. Neugebauer et al. (1999) and Rooij et al. (2010) studied the effect of the Dutch famine in the winter of 1944-45 on pregnant women and found that severe maternal nutritional deficiency early in gestation is associated with inferior brain and cognitive development of offspring. Economic studies that focus on nutrition like fasting during pregnancy (Almond and Mazumder (2011), Almond et al. (2014)) and

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

supply of iodine for pregnant women (Field, Robles, and Torero (2009) and Feyrer, Politi and Weil (2013)) found a positive relationship between appropriate nutrition of the mother during the pregnancy and cognitive abilities of the children in the long term.

In our study we examine the effects of in utero time of exposure to micronutrient supplement of iodine, iron and folic acid and to other improved conditions in Israel on the birth outcomes (birth weight) and academic achievements of children by the end of high school. More specifically, our research question is how would improvement of in utero environmental conditions affect later life cognitive outcomes? This out of Africa immigration, called "Operation Solomon", 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 brought to Israel almost all the Ethiopians Jews who lived in Ethiopia. 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. Being in utero in Israel meant exposure to advanced medical care technologies, prenatal conditions and nutrition typical to a developed country. In contrast, being in utero in Ethiopia meant exposure to conditions in one of the poorest developing countries. The goal of this paper is to exploit this unique natural experimental setup and examine whether these dramatic in utero environmental differences affected later life outcomes.

We construct a dataset based on high school administrative data linked to individual demographic records of all Ethiopian children born between May 27th 1991 – 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 micronutrient supplements and better environmental conditions in Israel. According to epidemiological studies the most critical period of pregnancy for child brain and cognitive development is the first trimester. We therefore examine how in utero exposure to micronutrient supplements and the Israeli environment during the first trimester of gestation (and afterwards) affects birth weight and medium-term cognitive outcomes. 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.

The medium-term outcomes we examine include the likelihood of repeating a grade during high school, dropping out of high school, and obtaining a matriculation diploma at end of high school, and the total number of matriculation credit units in all subjects and in Mathematics and English in particular. We view the latter outcomes as a measure of student's ability and of quality of her matriculation study program which is 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 a short -term outcome.

We find that children exposed to micronutrient supplements and better environmental conditions in utero during the first trimester of pregnancy performed substantially better in all medium-term cognitive outcomes relative to those who were exposed to these better conditions at a later stage of pregnancy. However, we do not found any effect on birth weight. Children who were in utero in Israel starting from the first trimester are about 10 percentage points more likely to obtain a matriculation diploma than children who were in utero in Ethiopia during the first trimester. This is a remarkably large effect since the average matriculation rate of children who arrived at the second and third trimester is 20 percent. Children who arrived during the first trimester also engage in more challenging study programs during high school. For example, they obtain 3-4 more credit units on average than the others, an effect of about 33 percent. These individuals also have 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 10 percentage points less likely to repeat a grade and 7 percentage points less likely to drop out of high school.

We assess the robustness of these results by controlling for birth cohort and seasonality effects. Particularly, we extend our regression discontinuity (RD) identification method by adding two comparison groups, which include children of respective 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 environmental condition in utero that we estimate is only for children who were in utero in Israel during the critical period, namely the first trimester and that cannot be explained by birth cohort or seasonality effects. Finally, we also examine treatment effects by gender and by parental education, following the heterogeneity observed in previous studies.[2] We find that the effect of better environmental conditions in utero is larger and only significant among girls. The effects by mothers' education show that early exposure to better environmental conditions reduces school repetition and dropout rates for children of all mothers, and increases the quality of matriculation diploma among girls whose mothers have some formal education. .

This research contributes to the existing literature by investigating the effects of better environmental conditions and micronutrient supplements 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 this century. Our findings on the critical period of in utero conditions has paramount implications for the understanding of intergenerational effects of immigration and has 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 rational for targeting resources at early childhood to

[2] See, e.g., Currie and Hyson (1999), Case, Lubotsky, and Paxson (2002), and Currie and Moretti (2007). Almond, Edlund and Palme (2009).

children of immigrant families that 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. Section 7 concludes and discusses future work.

2. Effect of in Utero Conditions

2.1 The Medical Literature

The epidemiological literature has explored the fetal origins hypothesis analyzing different effects and timing. According to the fetal origins hypothesis, which is associated with Barker (1992), certain chronic conditions later in life can be traced to the course of fetal development. The medical literature analyses the effects of different environmental shocks in utero not only on fetus health and health in adulthood but also on cognitive outcomes later in life.

Neugebauer et al. (1999) and Rooij et al. (2010) showed that cognitive function in later life does seem affected by prenatal under-nutrition caused by the Dutch famine after the end of World War II. Neugebauer et al. (1999) suggests that severe nutritional insults to the developing brain in utero may be capable of increasing the risk for antisocial behaviors in offspring. Rooij et al. (2010) found that men and women exposed to famine during the early stage of gestation performed worse on a selective attention task. Nowakowski and Hayes (2008) and Loganovskaja TK and Loganovsky KN (1999) investigated the effect of radiation exposure during pregnancy on cognitive abilities of the off-springs. Their findings showed that developmental events occurring in the fetus brain during weeks 8 to 25 of gestation have important effects on cognitive skills later in life. They reported 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. The exposure between 8 and 25 weeks of gestation is so 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) argue that a mother's iron deficiency early in pregnancy may have a profound and long-lasting effect on the brain development of the child, even if the lack of iron is not enough to cause severe anemia. 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.

2.2 The Economic Literature

Recent economic literature contributes to the identification of the effects of in utero conditions on later life outcomes. It often exploits a range of random shocks and circumstances affecting pregnant mothers and has found significant impacts on outcomes including test scores, educational attainment, income, and health. Earlier studies have shown that fetal health can be affected by a variety of subtle and less subtle shocks [Lien and Evans (2005a), Lien and Evans (2005b) Camacho (2008) Currie and Walker (2009)]. These studies use exogenous changes that influenced the environmental conditions of the mother and find that negative environmental shocks have a detrimental effect on fetal health after birth, often measured by birth weight. Other related studies [Currie and Hyson (1999), Behrman and Rosenzweig (2004), Black, Devereux, and Salvanes (2007) and Oreopoulos, Stabile, Walld, and Roos (2008)] evaluate the long-term effects of newborn outcomes (e.g. birth weight) on human capital.

The evidence on the link between environmental conditions in utero and fetal health and the connection between fetal health and outcomes later in life led to studies that examine the effect of environmental conditions in utero on long term human capital outcomes. Identification in these studies is based on comparing cohorts that were exposed to in utero shocks to cohorts that did not. For example Almond (2006) reports that children of Influenza Pandemic infected pregnant mothers were about 20% more likely to be disabled and experienced wage decreases, as well as reduced educational attainment. Almond et al. (2007) report that acute maternal malnutrition caused by the 1959-1961 Chinese famine was associated with greater risk of being illiterate, out of the labor force, marrying later (men), marrying spouses with less education (women) and lowered birth sex ratio (boys to girls). Almond et al. (2009) used the 1986 Chernobyl accident in Sweden and find that the birth cohort exposed to 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.

This paper is related to these studies by focusing on the connection between in utero environmental conditions and later life outcomes. But unlike them, the analysis in this study is based on a positive event of environmental differences caused by moving from a developing country with poor health care and living conditions to a western country with advanced medical care and better living conditions such as better hygienic and nutrition. One of the main differences that pregnant women faced upon immigration was the supplement of micronutrients. Previews economic studies that focus on nutrition and fasting during pregnancy [Almond and Mazumder (2011) and Almond, Mazumder and Ewijk (2014)] found a positive relationship between appropriate nutrition of the mother during the pregnancy and cognitive abilities of their children in the long term. Economic studies that focus on micronutrient supplementation examined only the effect of the supply of iodine for pregnant women. Field, Robles, and Torero (2009) found that iodine supplementation for pregnant women in Tanzania has large educational impacts on cognition and human capital of their children: children of treated mothers attain an estimated 0.35-0.56 years of additional schooling relative to their siblings and older and younger peers. Furthermore, the effect appears to be substantially larger for girls, consistent with laboratory evidence indicating greater cognitive sensitivity of the female fetus to maternal thyroid deprivation. Feyrer, Politi and Weil (2013) examine the impact of a positive intervention of salt iodization on cognitive outcomes in the US and find that for the one quarter of the population most deficient in iodine this intervention raised IQ by approximately one standard deviation. Our paper contributes to this literature by analyzing the overall effect of micronutrients (iodine, iron and folic acid) in utero on offspring cognitive outcomes in the medium run.

To date, there has been relatively little convincing empirical evidence about causal effects of a positive shock to in utero conditions. One such recent example is Hoynes et al. (2012) which evaluates the impact of the Food Stamps Program (FSP) as a positive policy-driven event that generated an increase in family resources available in utero and during childhood. Their findings suggest that access to the FSP in utero and in early childhood leads to a large and statistically significant reduction in the incidence of "metabolic syndrome" (obesity, high blood pressure, heart disease, diabetes) as well as an increase in reporting to be in good health. Another study related to ours is Van Den Berg et al (2012) which estimate the effects of changes in environmental conditions of immigrant children to Sweden by comparing siblings who immigrated at different age. While these studies examine variation in exposure to better environmental conditions after birth, we focus on exposure during the pregnancy period.

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. Some nutrients are more important than others during pregnancy, because they play a vital role in fetus development. The World Health Organization (WHO) (2004) considers that 1 out of 3 people in developing countries are affected by vitamin and mineral deficiencies. The three most important micronutrients in terms of health consequences for poor people in developing countries are: iodine, iron, and vitamin A. Iron, iodine and folic acid are among the most important micronutrients that are relevant for cognitions and affecting brain development. Under-nutrition and these micronutrient deficiencies among pregnant women in developing countries lead to high rates of infants born with low birth weight, and cause learning disabilities, mental, retardation, poor health and premature death.

Iron Deficiency (ID)

The WHO estimates that the highest proportion of individuals affected by anemia are in Africa and that in Ethiopia anemia is a severe problem for both pregnant (62.7%) and non-pregnant women of childbearing age (52.3%)[3]. According to the WHO report more than half of this anemia burden is due to iron deficiency, the rest partly due to deficiency of folic acid, vitamin B12, vitamin A, and due to parasitic infections. Iron deficiency and untreated iron deficiency anemia during pregnancy have many negative consequences for the offspring and have been shown to be associated with a higher incidence of low birth weight and prematurity[4] and long-term cognitive abnormalities.[5] Many developing central nervous system (CNS) processes are highly dependent on iron-containing enzymes and proteins. Thus, iron deficiency might have multiple and varied effects, particularly during the brain growth spurt. The structures of the brain can become abnormal because of iron deficiency either in utero or in early postnatal life because iron is essential for proper neurogenesis and differentiation of certain brain cells and brain regions. The cells involved in building the embryonic brain are most sensitive to low iron levels during the first trimester. Hence, the period that begins in the weeks prior to conception and extends through the first trimester to the onset of the second trimester is considered as a critical period for brain development. Iron deficiency during the third trimester is unlikely to harm the developing brain.[6]

Iodine Deficiency (IDD)

A recent WHO report note that more than two billion people (260 million of them in Africa) are estimated to be at risk of IDD. Iodine deficiency is now recognized by the WHO as the most common preventable cause of brain damage in the world today.[7] 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.[8] Ministry of Health (MOH) and the United Nations Children's Fund (UNICEF) figures suggest that in 1993, 78% of the population of Ethiopia was exposed to iodine deficiency and 62% are iodine deficient. The high level of iodine deficiency in Ethiopia continues to be a major problem even in recent years.[9]

Humans require iodine for biosynthesis of thyroid hormone. The thyroid hormones affect 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

[3] Worldwide prevalence of anemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005.
[4] Banhidy, Acs, Puho and Czeizel (2010).
[5] Lozoff and Georgieff (2006).
[6] Mihaila, Schramm, Strathmann , Lee, Gelein, Luebke , and Mayer-Pröschel (2011).
[7] Comprehensive Handbook of Iodine (2009).
[8] UNWFP (2013b), Ahmed et al. (2012).
[9] Iodine deficiency disorders module – Ethiopia public health training initiative (2007).

brain.[10] Up to mid-gestation the mother is the only 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.[11] A longitudinal study in China that assessed timing of supplementation 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.[12]

Folic Acid Deficiency

Although folic acid deficiencies are much less prevalent than iron deficiencies in the Third World, they nonetheless represent 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.[13] 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.

3.2. The Immigration of Ethiopians Jews to Israel

The Ethiopian Jewish community, known also as "Beta Israel", has lived in the region of Northern Ethiopia called Gondar for several centuries.[14] The origin of the Ethiopian Jews is obscure and according to some sources they relate to the lost tribe of Dan (one of the twelve tribes of Israel). The existence of this remote community became common knowledge in the American Jewish world only late in the 19th century. The Joint Distribution Committee (AJDC) sent money to the community, until World War II, when Ethiopia was regarded as a hostile country because of the Italian occupation. With the establishment of the state of Israel nothing was done to bring the Ethiopian Jews to Israel. Only in 1975 after the Chief Rabbinate ruling which determined that the Beta Israel were descendants of one of Israel's lost tribes, they were entitled to migrate to Israel as full citizens under the Law of

[10] Bror-Axel Lamberg (1991).
[11] Morreale de Escobar, Jesus Obregon and Escobardel Ray (2007).
[12] Cao, Jiang, Dou, Murdon, Zhang, O'Donnell, Tai, Amette, DeLong, and Delong (1994).
[13] Czeizel, Dobo , and Vargha (2004), Czeizel and Dudas (1992).
[14] 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.

Return. Since then, 92,000 Ethiopians were brought to Israel in organized immigration projects and they made "Aliyah" and become immediately Israeli citizens.

The immigration of Ethiopian Jews to Israel began on a very small scale, mainly through Sudan. Figure 1 present the immigration trend of the Ethiopians Jews from Ethiopia to Israel during the years. In the early '80s, the drought and consequent famine in Ethiopia and the unstable political situation led the Israeli government to act to bring this community to Israel. Between November 1984 and the beginning of 1985, 6,000 immigrants were airlifted from Sudan to Israel in a project known as "Operation Moses". They left Gondar in circumstances of drought and hunger and trekked across hundreds of kilometers to South Sudan; many of the sick, the old and the weak died on their way to Israel. News of the rescue leaked out to the foreign media in November 1985. As a result, President Numeiri of Sudan halted the operation for fear of hostile reaction from the Arab states.

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 opened new avenues and allowed for political and public pressure on the Ethiopian government, which was struggling with civil war, draught and famine. Jewish communities in the USA and Canada became more involved, working through two organizations in Ethiopia: American Association for Ethiopian Jews (AAEJ) and North American Conference on Ethiopian Jewery (NACEJ).

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 didn't know when they will be going to Israel and realized that they would be living in Addis Ababa for the time being. However, military events in Ethiopia pushed the Israeli government to act. On May 1991, after the Ethiopian dictator Mengistu fled from the country, the Israeli government realized that the Ethiopians Jews should be rescued before rebels take over Addis Ababa. On May 24 1991, over fourteen thousand Ethiopian Jews (almost the entire Jewish population remaining in Ethiopia) were airlifted to Israel within 36 hours. This operation was 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.[15] The immigration from Ethiopia to Israel continued after "Operation Solomon" but in small numbers, mainly from rural areas in Qwara near Gondar until 1999 and afterwards the immigration was mainly of the "Falash Mura" people while the last flight of immigrants from Ethiopia to Israel landed on August 2013.[16]

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

[16] "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.

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 to fifteen women who immigrated on "Operation Solomon" while there were pregnant 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 during pregnancy based on the information collected in these interviews, the medial literature on environmental conditions in Ethiopia, the literature on medical treatment administered to Ethiopian Jews and pregnant women upon immigration to Israel and on prenatal care in Israel at the time of immigration Salomon.

Living conditions: Prior to "Operation Solomon", the Ethiopian Jews were still living in hundreds of small remote villages in northern Ethiopia. Their lifestyle and beliefs were traditional, men plowed their fields with plows pulled by a brace of oxen, women spent their days carrying jugs of water long distances to their huts, foraging for scraps of firewood, spinning cotton, weaving their own cloth and taking care of their children. Less than 30 percent of the population was literate in their native languages and schools were not accessible to the majority of the population.

In May 1990, large part of this population migrated to Addis Ababa, where they were housed in refugee camps scattered all over the city, waiting for immigration to Israel without knowing the specific date. The living conditions in Addis Ababa were not better than in the rural areas they came from. After their arrival to Israel, immigrants were housed in 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. At the beginning of their stay in Addis Ababa, the medical services did not function and many of the Jews in the camps fell ill with diseases such as malaria, hepatitis and tuberculosis. The AJDC rapidly developed a comprehensive medical program during a 3-week period commencing on August 20, 1990. A vaccines program succeeded to reduce mortality. Israeli doctors trained health practitioners from the Ethiopian community that made home visits and provided medical services to approximately 4,000 families. The major issues of concern were cases of tuberculosis and vaccination of children. These programs reduced significantly the death rate in the following months. [M.Myers (1993)].

After arrival to Israel the immigrants received health coverage through the universal public health system and modern medical care though gaps in culture and language limited the utilization of these services by the immigrants. The Israeli health authorities developed an education health program to bridge these gaps and promote effectively the transfer of skills to the immigrants regarding proper health care, nutrition, western perception of prescribed medications, and personal hygiene [Levin-zamir, Lipsky, Goldberg and Melamed (1993)].

Nutrition: The traditional Ethiopian diet consisted of unrefined flours, legumes, grains, beans, vegetables, minimal meats, and few refined sugars and processed foods. Upon arrival in Israel, the immigrants' eating habits changed. Many of the traditional Ethiopian staples were unattainable. In the absorption centers in Israel they were served Israeli style food communally. Some lived in mobile home camps where they purchased food and cooked for themselves, incorporating Israeli food products into their diets. The traditional Ethiopian diet is based upon sour-dough pancake called *injera*, usually made from *teff*, an indigenous Ethiopian grain rich in protein, vitamins and iron. Since teff is not readily available in Israel, the immigrants make injera out of refined white flour [Levin-zamir, Lipsky, Goldberg and Melamed (1993)]. According to the International Food Policy Research Institute (IFPRI) in 1993 the calorie supply per capita in Ethiopia was 1,516 while in Israel it was twice as large (3,089 according to the Israeli central bureau of statistics).

Micronutrient supplements for pregnant women: As described before there are three main micro nutrient supplements, which are important for cognition and their intake is recommended for pregnant women: iron, iodine and folic acid. According to DHS 2011 report, less than 1% of pregnant women aged 15-49 in Ethiopia took iron supplements. Furthermore, iodine deficiency disorder is a major public health problem in Ethiopia (WHO). In contrast, it was a standard practice to prescribe vitamin and iron supplement to pregnant women in Israel around the time of operation Salomon. Moreover, Ethiopian women agreed to take these supplements since they thought that in Ethiopia this was not needed because *"the food was better, it contains more vitamins than the food in Israel"* [Granot, Spitzer, J.Aroian, Ravid, Tamir and Noam (1996)]. Also there is no evidence of iodine deficiency disorders among pregnant women in Israel. The reason seems to be that Israel's food chain contains adequate amounts of iodine (Benbassat et al. (2004)).[17]

Health Care and Pregnancy Monitoring: Ethiopian women who lived in rural areas shared the view that pregnancy does not require medical attention. They gave birth at home with assistance from family and neighbors and a traditional birth attendant or lay midwife. In contrast, in Israel, pregnancy is closely monitored and baby and mother are examined periodically before and after birth. 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.[18] The Ethiopian immigrant's beliefs that pregnancy outcomes are all at god’s will and that medical care is irrelevant were unchanged upon arrival to Israel. Thus low utilization of pre- and postnatal health care in Israel was documented among the Ethiopian immigrants. However, most deliveries of Ethiopian babies were at hospitals with the

[17] Israel is one of the few countries that have no iodization policy and where a national iodine survey has never been done as for 2013. This is in part due to the unfounded but widespread belief that proximity to the sea prevents iodine deficiency so Israel is an iodine-sufficient country due to its proximity to the Mediterranean (Zohar (1994)).

[18] The World Bank 1990/1.

assistance of formally trained professionals rather than traditional home delivery practices as in Ethiopia. All the women in our survey mentioned that in Ethiopia they did not received any medical care related to the pregnancy while in Israel they were under medical monitoring which included blood tests and ultrasound. According to the World Bank in 2000 100% of the pregnant women in Israel were receiving prenatal care while in Ethiopia only 27% of the pregnant women received prenatal care.

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 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 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 this data to administrative records collected by the Israeli Ministry of Education which includes information on students parental education, yearly schooling status (graduated, currently attending school, dropped out) and high school matriculation exams outcomes.[19] 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 matriculation certificate. The second type of outcomes measure quality of schooling and includes the following variables: total credit units awarded in the matriculation certificate and credit units in mathematics and English. We do not use test scores as outcomes because a large proportion of our sample do not sit for the matriculation exams or do only some of them.

Our primary sample includes 594 students who were born in Israel but their 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. 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

[19] Since our sample is on students born between 1991 and 1992 they all should be high school graduates in 2011 or at least be high school students. A matriculation certificate is a prerequisite for admission for academic post-secondary institutions. There are also many employers who require this certificate. Students award a matriculation 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 difficulty, with each test awarding the student between one and five credit units per subject, varying by the difficulty of the exam (one is the lowest level and five the highest).

1991 and February 15th 1992) for comparison purpose. Column 1 presents means of background and outcome variables for the children in our primary sample (students born in Israel between May 27th 1991 and February 15th 1992 whose mothers immigrated on May 1991). Column 2 presents the respective means for students born in Israel at the same time to Ethiopian parents who arrived to Israel before 1989 and column 3 presents the respective means for students born in Ethiopia at the same time and who immigrated to Israel after 1991 but before 2000. 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. In addition, parents average years of schooling is 2.3 and 2.5 which is less than a half of the average years of schooling of children born in Israel to parents from Ethiopian origin (5.3 for the fathers and 5.03 for the mothers in column 2) but it is similar to the average years of schooling 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.

The means of the outcome variables in our primary sample are also lower than those of children born in Israel to Ethiopian parents (column 2) but they are marginally higher than those of the Ethiopian born sample (column 3). For example, the matriculation 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, 45.7 percent. 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, 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. The birth weight 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.

In Figure 2 we present the birth distribution for all these three groups and their respective older cohorts. In panel A we present the birth distribution for our main sample - "Operation Solomon" offspring who born between May 27th 1991 and February 15th 1992 and the respective older cohorts of "Operation Solomon" offspring who born in Ethiopia before the operation between May 27th 1990 and February 15th 1991. In panel B we present the birth distribution for children born in Israel at the same time (May 27th 1991 and February 15th 1992 and May 27th 1990 and February 15th 1991) to Ethiopian parents who arrived to Israel before 1989. Panel C show the birth distribution for children born in

Ethiopia at the same time and immigrated to Israel after 1991 but before 2000.[20] It can be seen that there are no differences in the distribution of number of births by month of birth in our main sample compare to all the other groups. This indicates that the immigration or any other events during the stay in Addis Ababa did not affect the timing of inception of pregnancies.

5. Empirical Strategy

5.1. Baseline Model and Specification

The main goal of this paper is to analyze the casual effect of exposure to better environmental conditions in utero, on later life outcomes. However, it is often difficult to identify the casual effect due to unobserved factors that are correlated with environmental conditions faced by the mother during pregnancy and with later life outcomes of the child. "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. But 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.[21]

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

[20] Some of the children who were born in Ethiopia don't have information on exact date of birth, and have only the year of birth since it was unknown at immigration. We gave these children random day and month of birth.

[21] We note, however, that immigration can have some negative aspects. For example, by adding stress with potential harmful effects for pregnant women. A recent study by Black, Devereux and Salvanes (2013) find that stress during pregnancy that is related to parental death has small negative effects on birth outcomes but no effects on adult outcomes. On the other hand, Aizer et al. (2009) find that in-utero exposure to elevated stress hormone cortisol have negative effects on health and educational attainment of offspring. In our context, such effect can be part of our measured treatment effect if the potential physical and emotional implications of immigration were stronger for women at late stages of pregnancy.

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.[22] As a result, there should not be any correlation between immigrant's characteristics and the decision to immigrate. Therefore, a comparison between children who were exposed to better environmental conditions at a different gestational age but experienced the same conditions on birth and later life allows us 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 22 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, schooling outcomes are a good predictor for adult achievements in the job market. Our basic identification strategy differs from previous design-based studies in the fetal origins literature. Typically, natural experiments induced by famines, disease outbreaks, etc., 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 in order to examine whether the main channel that explains our results comes from improved newborns health.

The key variable for our analysis is the gestational age of the student 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 by the assumption of 38 weeks post conception gestation. 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[23]: (1) gestational age between conception time and week 10 of gestation where exposure to the Israeli environmental conditions started during the first trimester, (2) gestational age between week 11

[22] It is reasonable to assume that there was no birth planning among the Ethiopian Jewish population before immigration. An article published in January 2008 in the daily newspaper "Yediout Hacharonot", claimed that contraception Defoe was administered systematically to Ethiopian women before they migrated since the mid 1990's. We also note that contraception Defoe received the FDA approval only in 1992 and was first used in Israel 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.

[23] The medical literature define the three trimesters by assuming 40-42 weeks of pregnancy, hence we adjusted our definition for the trimesters to the assumption of 38 weeks post conception gestation.

and week 24 of gestation and (3) gestational age between week 25 and birth. These three trimesters of gestational age 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[24], the second trimester includes children born between August 28th 1991 and December 4rd 1991, and the third trimester includes children born between May 27th 1991 and August 27th 1991. Figure 3 illustrates how we built these groups.

The medical literature, (e.g. Cunningham, Leveno, Bloom (2009)) suggests that the first trimester is a period of rapid growth, and the fetus main external features begin to take form including the brain. We therefore refer to the first trimester group as the "fully treated" group; the second trimester group is "partly treated" and 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 student 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), so that the estimated parameters reflect the incremental effect of the additional trimester spent in better environmental conditions and with micronutrient supplements. X_i is a vector of student's i characteristics which include mother age at birth, parents age gap, birth order, parents' education, SES of the mother's first locality of residence upon immigration to Israel, gender and indicator for twins.[25]

If micronutrient supplements and better environmental conditions in utero enhance cognitive abilities, we will 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.

This basic specification presented in equation (1) does not include cohort and month of birth effects because they are perfectly correlated with the treatment definition. Since we restrict our sample to

[24] This group might include also some children conceived in Israel who were born ahead of time. However, dropping children who were born in February do not change our results.

[25] The Israeli Central Bureau of Statistics 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.

children born in a range of nine months only, we believe that the scope for cohort effect is very small. Nevertheless, we address these issues below by adding additional comparison groups to estimate month of birth and cohort effects.

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. Educational outcomes may suffer from seasonality effects because the age cutoffs that determine school entry lead to a sharp discontinuity in school performance by timing of birth. 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.

We consider two such comparison groups: comparison group A - second-generation immigrants from "Operation Moses" (immigrated before 1989) and comparison group B - Ethiopians who immigrated with their families after "Operation Solomon". 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 main wave of immigration prior to "Operation Solomon" was "Operation Moses" that took place between 1984 and 1985 and brought to Israel over 6,000 immigrants. We include in the comparison group the children born in Israel from May 27th 1991 to February 15th 1992 to Ethiopian families from this earlier wave of immigration. Since the entire pregnancy of these children was in Israel, they all were fully treated. Therefore, differences between young and older cohorts and 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 this comparison group. We therefore add a second comparison group, children born in Ethiopia between May 27th 1991 and February 15th 1992 who immigrated to Israel after May 1991 but before 2000.[26] This group will capture any seasonality effect in timing of conception in Ethiopia of our main analysis sample. 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 the young and older cohorts in this group should only reflect cohort effects and seasonality in the timing of conception in Ethiopia.

The "Operation Solomon" group and the two comparison groups were different in many aspects. However, all the students in our sample – those who were born to parents who immigrated in

[26] 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 "Flash murra" 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 students who immigrated to Israel with their families on May 1991. These students 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 students born in Ethiopia who immigrated with their parents after 1991.

We estimate the following model:

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

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

6. Results

6.1. Balancing Tests on Observables

[27] 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.

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.

Table 2 presents summary statistics for these observable 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 columns 3 presents characteristics for children whose mothers arrived to Israel at the latest stage of the pregnancy (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. In Columns 4, 5 and 6 we report the difference in means and their standard errors between these three groups.

Fathers' average years of schooling is 2.2 for the group who arrived to Israel at the earliest stage of the pregnancy (first trimester), 0.28 years lower than the mean of second trimester and 0.16 lower than the mean of the third trimester, which includes those children who arrived to Israel at the latest stage of the pregnancy. Mothers' average years of schooling is 2.08 for the first trimester group which is about 0.6 years lower from the other two trimesters (2.6 years for the second trimester and 2.75 for the third trimester). These means indicate that parents of children who arrived to Israel at the earliest stage of the pregnancy are the least educated, which is against our concern for 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. On the other hand, the family annual income four years after immigration is slightly higher in the first trimester group by more than 1000 NIS (equal to $250) compare to the second and third trimester groups. However, all these differences are not statistically significant.

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. The mean age of the mother at birth is the first trimester group is 31.3, slightly higher but not significantly different from the other two groups (31.3 versus 30.5 in the second and third trimester). 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 different is insignificant. There are also no statistical differences in the average birth-spacing, number of siblings and birth order.

Overall, differences in parental characteristics and family structure do not point to any particular advantage of one group relative to the others. Moreover 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.

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 gestational age at time of immigration greater or equal to 25 weeks (i.e. 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 (se =0.036) less likely to repeat a grade during high school and 5.4 percentage points (se =0.037) 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 11.4 percentage points (se =0.038) and 6.7 percentage points (se =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.

Performance in the matriculation exams is also improved by a longer exposure to treatment. Students who were exposed to these conditions starting from the first trimester are 11.7 percentage points (se =0.052) more likely to obtain a matriculation diploma by the end of high school compared to students exposed in the last trimester. These effects are larger 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 matriculation rate is very large relative to the mean of this outcome in the two other groups which is about 20 percent: it means that exposure to micronutrient supplements (mainly iron, iodine and folic acid) and better in utero conditions in Israel from the first trimester improved the matriculation 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 matriculation rate in our sample is substantially low compare to the matriculation 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.

The above gains are accompanied by improvements in other measures of quality of the high school matriculation study program. The estimates reported in columns 7 through 12 show that exposure in utero to micronutrient supplements and to Israeli environmental conditions during the first trimester has positive and significant effects on quality of the matriculation program. The total matriculation credit units increased by 3.2 (s.e. =1.089), 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 matriculation diploma by the end of high school which are slightly smaller. The DID estimates for the quality of the matriculation program are slightly lower from the respective OLS estimates but not statistically significant different. Again, the results suggest that early exposure to better environmental conditions and micronutrients improve the quality of the matriculation diploma. On the other hand, 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.

6.3. Placebo tests

An additional test for the validity of the design is to estimate the model by limiting the sample to those who are unlikely to have been impacted by the treatment. In Tables 5a and 5b, we apply this placebo tests by focusing on individuals who were not exposed to different environmental conditions in utero but were born during the period of interest. We define the treatment groups for the placebo test by the respective birth date of the original treatment definition. For example $First\_Trimester_i$ equals 1 if the student was born at the same range of birth dates as the treatment group in our main sample (between December 4th 1991 and February 15th 1992).

Columns 1 thought 3, 5 thought 7 and 9 thought 11 in tables 5a and 5b present estimates for β_1 and β_2 from equation (1) for four different samples. Columns 1, 5 and 9 present estimates for the sample of the older cohort of the "Operation Solomon" immigrants (students who were born between May 27th 1990 and February 15th 1991 in Ethiopia and their parents immigrated to Israel in "Operation Solomon"). The results show much smaller and insignificant effects except for the English units. Columns 2, 6 and 10 present estimates for the sample of the second-generation immigrants from "Operation Moses" (students who were born between May 27th 1991 and February 15th 1992 in Israel and their parents immigrated to Israel before "Operation Solomon"). The estimated effects for this sample are in the same direction as our main results but the effects are smaller and for some of the outcomes imprecise. Columns 3, 7 and 12 present estimates for the sample of the Ethiopians students who were born between May 27th 1991 and February 15th 1992 and immigrated with their families after "Operation Solomon". These results show small, imprecise and sometimes in the wrong direction for all our school cognitive outcomes. Columns 4, 8 and 12 in tables 5a and 5b present estimates for β_1 and β_2 from equation (2) for the sample of the comparison groups only. These columns present estimates for the two cohorts of the second-generation immigrants from "Operation Moses" and the Ethiopians students who were born in Ethiopia and immigrated with their families after "Operation Solomon" (students who were born between May 27th 1991 and February 15th 1992 and between May 27th 1990 and February 15th 1991). The results on table 5a show wrong-direction impacts on the probability of grade repetition and high school dropout. However, it shows positive and significant effect on the probability to obtain matriculation diploma. The results on table 5b show small and imprecise impacts for all our quality of the matriculation program outcomes.

Overall, evidence presented in these placebo tests show no systematic association between date of birth and outcomes among children who were born in the same period of interest but were not exposed to different conditions in utero (either because they spent all their pregnancy in Israel or in Ethiopia). These results show that our main findings are unlikely to be confounded with other factors that could be associated with date of birth and could affect students' outcomes.

6.4. Heterogeneity in the Effect of In-utero Environmental Conditions

a. Heterogeneity in treatment effect by gender

Table 6 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 although differences in magnitude of the estimated effects between boys and girls are insignificant according to the reported p-values except from the effect on English units. 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.

Evidence for a larger impact for girls is consistent with the findings of Field et al. (2009) which also investigate the effect of in utero micronutrient supplement, or more specific iodine. Field et al. (2009) find that delays in resupply of iodine for pregnant women in Tanzania has large educational impacts on their children, with larger improvements for girls. Our results are also consistent with other related literature. For example, Baird, Friedman and Schady (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 was evident in short term outcomes such as schooling and in long term outcomes such as employment and earnings at age 55-60.

b. Heterogeneity in treatment effect by mother's education

Since we focus on environmental conditions during pregnancy, it is interesting to analyze the differential effects by mother characteristics. We therefore examine treatment effects by mother's years of schooling. Most of the mothers in our sample (above 50 percent) have zero years of schooling and for some of them this information is missing (less than 10 percent). The average among those who have some years of schooling is still very low; it is about 7 years of schooling. We stratify the sample in two groups: those whose mothers have zero years of schooling or have a missing valueand those whose mothers have one year of schooling or more. [28]

Results of our two main specifications are presented in Table 7 where we also report the means of the outcome variables for each sample. The evidence shows that the effect of exposure to micronutrient supplements and better environmental conditions in utero starting from the first trimester of gestation on schooling attainment (except for the likelihood of obtaining a matriculation diploma) is much larger and significant among children whose mothers have no formal schooling. The treatment effect on the quality of the matriculation program is similar between those with mothers

[28] 57.5% of the mothers with missing value for schooling have no income in 1995 and another 10% have annual income less than $1200 in 1995. However, only 17.5% of the mothers with some education have no income in 1995. Hence, we think it is reasonable to classify mothers with missing value for schooling as zero schooling.

with no education and those whose mothers have some schooling although the effects among the children whose mothers have no formal schooling are more precise..

In the previous section we found that the positive and significant effect of early exposure during the pregnancy to micronutrient supplements and better environmental conditions can be attributed to girls only. We therefore present in Table 8 results stratified by mother's education for girls. The evidence in table 8 shows that for girls, the effect of exposure to micronutrient supplements and to better environmental conditions in utero during the first trimester of gestation is much larger and significant in most of the schooling and matriculation outcomes among girls whose mothers have some formal schooling. For example, girls whose mothers arrived to Israel during the first trimester improved the matriculation credit units by more than 50 percent. The size of the effect is very large relative to the outcome means.

These results are consistent with previews findings in the literature. For example, previous studies find that the negative impact of poor fetal health [Currie and Hyson (1999)] or exposure to negative shocks in utero [Almond, Edlund and Palme (2009)] on human capital accumulation is greater in low-education or low-income families. The explanation given for this finding is that higher educated families tend to compensate for negative shocks to fetal health or to poor birth health outcomes. Moreover, negative shocks have usually smaller effects on children in high income families because they are less vulnerable. In our analysis, we evaluate the effect of a positive shock and obtain the opposite result. The explanation can be that mothers with some formal education are able to take more advantage of a positive environmental shock by accessing to better medical technologies and nutrition. However, we still find significant effects also among the low educated mothers. The reason for that can be the fact that our treatment is combination of serval environmental differences experienced by the mothers. Some of these environmental differences, such as iron intake and pregnancy monitoring, require an active action in order to benefit from them,while others do not require any active action, like exposure to iodine which is in the soil in Israel. Mothers with no formal education are more likely to have benefited from the exposure to iodine, but probably less likely to have benefited from iron supplements and pregnancy monitoring.

6.5. Possible Mechanisms

a. Birth outcomes

Previous studies have shown that birth weight can be affected by a variety of shocks during the fetal period (Lien and Evans (2005a), Lien and Evans (2005b) Camacho (2008) Currie and Walker (2009)). Following that, a growing empirical literature shows a positive relationship between birth outcomes and educational attainment (Currie and Moretti (2007), Oreopoulos et al. (2008), Black et al. (2007) and Royer (2009)). The exposure to micronutrient supplements and better environmental conditions in utero may have also influenced early fetal outcomes. Since birth weight is a relatively crude measure of fetal health, we use the birth records to evaluate the effect of exposure to micronutrient supplements and better environmental conditions in utero on fetal health.

Table 9 presents the estimates of the treatment effect on birth weight for the baseline RD specification and for the DID specification including only the cohorts born in Israel between May 27th 1991 and February 15th 1992.[29] In addition, the table show estimates for the probability of low birth weight (less than 2500 grams) and very low birth weight (less than 1500 grams). We also report means of the outcome variables for each sample and treatment effects estimates by gender. Results reported in columns 1, 2, 5, 6, 9 and 10 of table 9 are based on equation (1). Results reported in columns 3, 4, 7, 8, 11 and 12 are based on equation (1) and include also an indicator variable for comparison group A and month of birth fixed effects.

The estimates from models that control for month of birth fixed effects are insignificant and not different from zero. Estimates for girls are not significant. This implies that the large treatment effect on schooling outcomes observed among the girls are not related to fetal health. It also reduces the concerns that results observed on schooling outcomes are due to selection since if there was selection driving our results we should have seen this also in terms of birth weight. Estimates for boys show some positive effect on birth weight from exposure in the second trimester but no effects from the first trimester, The significant effects on birth weight among the boys are at the opposite direction of the selection that might drive the results for schooling outcomes.

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. Field, Robles, and Torero [2009] showed that delays in iodine supplementation during pregnancy have large and robust educational impacts, but health at school age, by contrast, appeared unaffected. Almond et al. (2009) found that radiation exposure between week 8 and 25 of gestation harm school achievement but do not affects birth weight and hospitalizations at school age.

A possible explanation for our results on birth weight is that improvements in all the three micronutrient supplements (iron, iodine, and folic acid) which are the main difference in the in utero environmental conditions of our sample, 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. So, it might be a catch up effect as documented by Akter et al. (2012) that Nutrition education only during the third trimester reduced 78% of low birth weight.

b. high school quality

Table 10 presents results for equations (1) and (2) using measurements of high school quality as dependent variables to show that there is no selective timing of pregnancies related to high school quality. Although "Operation Solomon" immigrants sorted randomly to absorption centers across the country (Gould, Lavy and Paserman (2004)), we might worry that children whose mothers arrived to Israel at earlier stage of the pregnancy end up somehow in better high schools than children whose

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

mothers arrived at a later stage of their pregnancy. If this is the case, then the estimate effects we observe are confounded by high school quality. We compute four measurements for high school quality for the years 2003-2005, before students in our sample enroll in high school: matriculation rate, mean total matriculation units, mean math matriculation units and mean matriculation test scores. All estimates reported in the table show no evidence for an association between gestational age at time of immigration and high school quality.

7. Potential Longer Term Returns

In order to understand if the in utero environmental differences matter it is important to analyze the economic payoff and the expected gains from this kind of "intervention". Since the individuals in our sample are only 22 years old, we cannot analyze their post-secondary schooling and labor market outcomes. Hence, we construct a database from administrative records provided by the National Insurance Institute of Israel (NII) including older cohort of individuals who were born in Israel but their parents emigrated from Ethiopia before "Operation Solomon" (that is "Operation Moses" off-springs). The administrative records provided by the NII include information on earnings and post-secondary enrollment. We linked this data to administrative records collected by the Israeli Ministry of Education which include information on the individual's matriculation program.

Table 11 presents the relationship between matriculation outcomes, post-secondary schooling, and earnings by age 30-32. All the estimates are based on regressions that control for gender, parents years of schooling and number of siblings. Column 1 shows the adjusted correlation between the matriculation outcomes and annual wage at the year 2012. Individuals with a matriculation diploma earned about 5,000 shekels more a year (about $1250), an additional credit unit in the matriculation certificate is translated to 376 shekels (almost $100) and the study advanced math (5 units) is associated with 6800 shekels ($1700) although this last association is imprecise. Column 2 show the adjusted correlations between the matriculation outcomes and post-secondary schooling, column 3 shows the equivalent adjusted correlations with university attendance and column 4 shows the adjusted correlations with the accumulation years of schooling at university.[30] All the matriculation outcomes are positively associated with higher education outcomes.

The gains to the individuals in our sample due to their mothers' arrival to Israel during the first trimester of pregnancy will most likely be translated in the next 4-5 years to gains in post-secondary schooling and later on into earning gains. These gains definitely can compensate for the cost of providing some of the in utero environmental differences, mainly the three elements of micronutrient supplement - iron, iodine and folic acid, during pregnancy.

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[30] 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.

8. Conclusions

This paper examines the role of in utero environmental conditions and micronutrient supplements (mainly iron, iodine and folic acid) on offspring educational outcomes. 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.

The results suggest that children who were exposed to micronutrient supplements and to better environmental conditions in Israel during the first trimester had substantially higher educational outcomes by age 18, including a lower likelihood of school repetition and dropout, a higher likelihood to obtain a matriculation diploma and to graduate with a higher quality matriculation study program, with larger improvements for girls. The effects sizes are very large, especially compared to the low counterfactuals for this group. These results are robust with respect to alternative comparison groups that attempt to control for seasonality of births and cohort effects. Moreover, the expected gains are high in terms of post-secondary schooling and expected earnings at adulthood.

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. The implications of these findings are especially 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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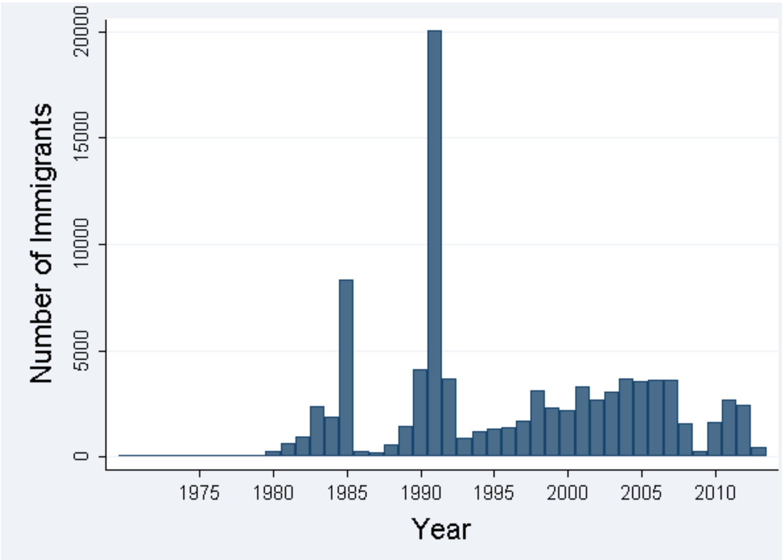
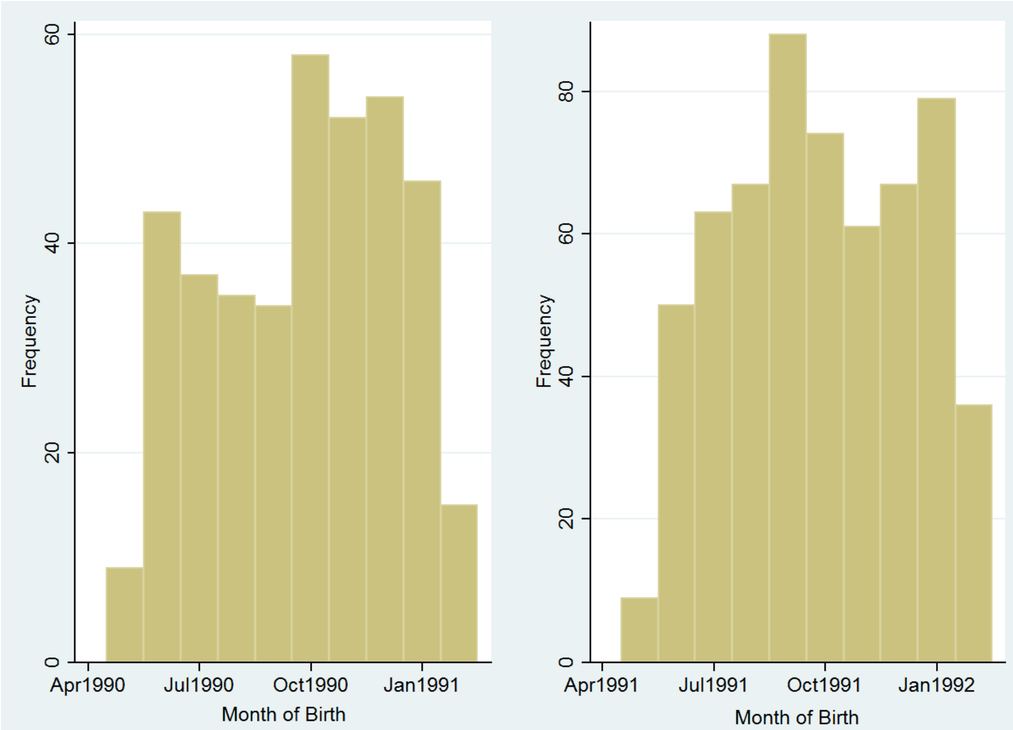
Figure 1: The immigration trend of the Ethiopians Jews from Ethiopia to Israel during the years 1975 - 2010.



Source: Israel Central Bureau of Statistics.

Figure 2: Birth Distribution

Panel A: "Operation Solomon" offspring – parents immigrated on May 24th 1991



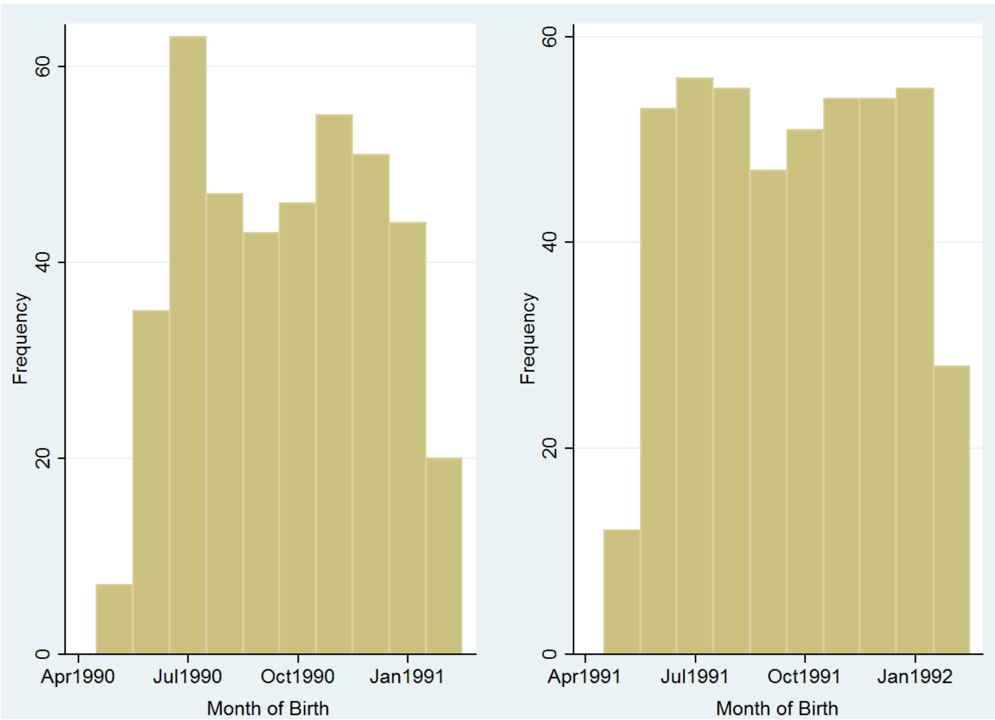
Students born in Ethiopia

May 27th 1990 – February 15th 1991

Students born in Israel

May 27th 1991 – February 15th 1992

Panel B: "Operation Moses" offspring – parents immigrated before 1989



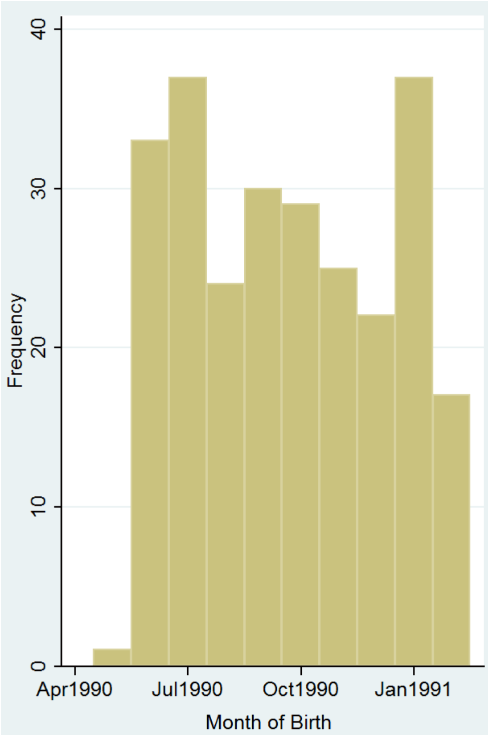
Students born in Israel

May 27th 1990 – February 15th 1991

Students born in Israel

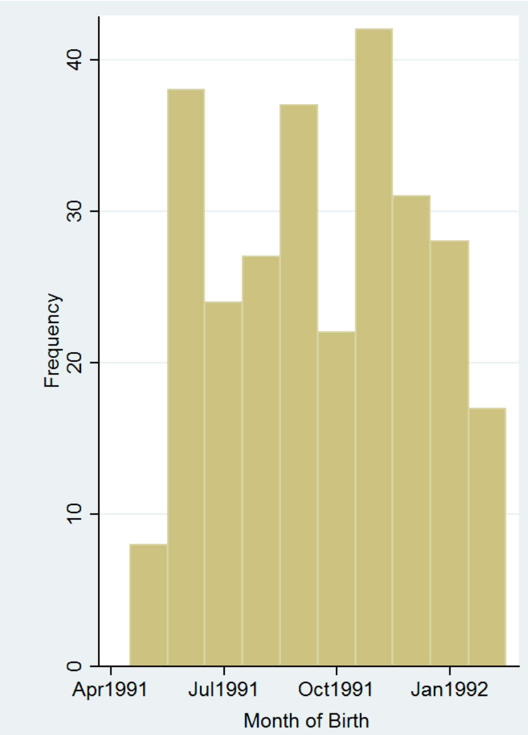
May 27th 1991 – February 15th 1992

Panel C: After "Operation Solomon" offspring – parents immigrated after 1992



Students born in Ethiopia

May 27th 1990 – February 15th 1991



Students born in Ethiopia

May 27th 1991 – February 15th 1992

Figure 3: The definition of the three treatment groups.

Year & Month of Conception	1990 September	1990 October	1990 November	1990 December	1991 January	1991 February	1991 March	1991 April	1991 May
Year & Month of Birth	1991 June	1991 July	1991 August	1991 September	1991 October	1991 November	1991 December	1992 January	1992 February

Gestational Age at Migration	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Third Trimester | Second Trimester | First Trimester

Table 1: Descriptive statistics

	Primary Sample	Comparison Samples - Ethiopian Origin	
	"Operation Solomon" Students	Israeli Born Students (Parents immigrated before 1989)	Ethiopian Born Students immigrated after 1991
	(1)	(2)	(3)
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)
Parents age gap	10.90	6.957	9.493
	(7.315)	(5.777)	(6.256)
Number of sibling	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	2.363	5.330	2.627
	(3.856)	(5.320)	(4.250)
Mother's years of schooling	2.502	5.032	2.343
	(3.875)	(5.137)	(3.814)
SES of the mother's first locality of residence upon immigration to Israel	-0.039	-0.004	0.115
	(0.546)	(0.556)	(0.473)
Family income 1995	16,397	47,255	6,896
	(14274.3)	(33537.3)	(12238.9)
Family income 2000	26,409	70,367	19,510
	(31240.1)	(54495.5)	(28423.7)
Outcomes			
Did not repeat 6-12th grade	0.806	0.824	0.800
	(0.395)	(0.382)	(0.401)
Did not dropped out of high school before completing 12th grade	0.848	0.873	0.859
	(0.359)	(0.333)	(0.348)
Obtained a matriculation diploma matriculation exams	0.305	0.351	0.319
	(0.461)	(0.478)	(0.467)
Total matriculation units	11.58	12.85	11.98
	(11.14)	(10.84)	(11.12)
Math matriculation units (0 to 5)	1.276	1.465	1.289
	(1.508)	(1.507)	(1.554)
English matriculation units (0 to 5)	1.978	2.374	1.944
	(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)	
Number of students	594	465	270

Notes: Standard deviations are presented in parenthesis. The students 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	Second Trimester	Third Trimester	Difference between First and Second	Difference between First and Third	Difference between Second and
	(1)	(2)	(3)	(4)	(5)	(6)
Father's years of schooling	2.194	2.480	2.361	-0.286	-0.168	0.119
	(3.492)	(4.086)	(3.876)	(0.402)	(0.413)	(0.409)
Mother's years of schooling	2.078	2.611	2.750	-0.532	-0.672	-0.139
	(3.448)	(4.045)	(4.007)	(0.401)	(0.421)	(0.415)
SES of the mother's first locality of residence upon immigration to Israel	-0.091	-0.013	-0.023	-0.078	-0.068	0.010
	(0.549)	(0.598)	(0.465)	(0.058)	(0.054)	(0.054)
Family income 1995	17335	15880	16184	1455	1151	-304
	(14923)	(14298)	(13632)	(1453)	(1515)	(1378)
Female	0.462	0.506	0.462	-0.044	0.001	0.045
	(0.500)	(0.501)	(0.500)	(0.050)	(0.053)	(0.049)
Mother's age at birth	31.29	30.51	30.47	0.779	0.816	0.038
	(9.616)	(8.464)	(8.748)	(0.895)	(0.975)	(0.845)
Parents age gap	9.965	11.53	10.96	-1.562**	-0.991	0.571
	(6.305)	(8.188)	(6.928)	(0.744)	(0.704)	(0.755)
Birth-spacing (years to the next birth)	2.457	2.363	2.597	0.095	-0.139	-0.234
	(2.167)	(2.152)	(2.299)	(0.215)	(0.237)	(0.218)
Number of sibling	5.422	5.301	5.330	0.121	0.092	-0.028
	(2.021)	(1.829)	(1.972)	(0.191)	(0.212)	(0.186)
Birth order	3.653	3.640	3.764	0.013	-0.111	-0.124
	(2.222)	(2.159)	(2.243)	(0.218)	(0.237)	(0.216)
Median Week of Gestation on Arrival to Israel	5	18	31			
Number of boys	93	118	98			
Number of girls	80	121	84			
Toal number of students	173	239	182			

Notes: Standard deviations are presented in parenthesis. First trimester includes students who born between December 4th 1991 and February 15th 1992, Second trimester includes students who born between August 28th 1991 and December 3th 1991 and Third trimester includes students who born between May 27th 1991 and August 27th 1991.

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

Dependent variable	Did not repeat 6-12th grade		Dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation 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***	0.114***	0.054	0.067*	0.134**	0.117**	3.616***	3.241***	0.469***	0.441***	0.565***	0.507***
	(0.036)	(0.038)	(0.037)	(0.039)	(0.053)	(0.052)	(1.047)	(1.089)	(0.146)	(0.153)	(0.169)	(0.176)
Second Trimester	0.053	0.055	0.029	0.032	0.065	0.064	2.093**	2.230**	0.270	0.281	0.343**	0.357**
	(0.038)	(0.038)	(0.038)	(0.037)	(0.052)	(0.055)	(1.009)	(1.022)	(0.160)	(0.170)	(0.150)	(0.146)
F test for (p-value): First Trimester = Second Trimester	0.116	0.066	0.399	0.264	0.186	0.301	0.126	0.290	0.136	0.237	0.132	0.302
Number of students	594		594		594		594		594		594	

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy. Each Colum is from different regression. Controls includes both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality in Israel, birth order and dummy for twins. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992.

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

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

Dependent variable	Did not repeat 6-12th grade		Dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation 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	0.094***	0.109***	0.055*	0.068**	0.075	0.072	2.416**	2.443***	0.397***	0.403***	0.266	0.279*
	(0.015)	(0.018)	(0.030)	(0.028)	(0.044)	(0.046)	(0.866)	(0.827)	(0.100)	(0.106)	(0.159)	(0.155)
Second Trimester	0.033	0.030	0.018	0.013	0.014	0.009	1.146	1.160	0.175*	0.178*	0.147	0.166
	(0.034)	(0.038)	(0.034)	(0.036)	(0.042)	(0.043)	(0.783)	(0.788)	(0.089)	(0.103)	(0.160)	(0.159)
F test for (p-value): First Trimester = Second Trimester	0.074	0.034	0.211	0.059	0.206	0.171	0.111	0.075	0.010	0.010	0.347	0.375
Number of students	2,388		2,388		2,388		2,388		2,388		2,388	

Notes: Standard errors presented in parenthesis are cluster at month of birth. Each Colum is from different regression including month of birth FE. Controls includes both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality in Israel, birth order and dummy for twins. The two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.

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

Table 5a: Placebo Test for Estimated Effect of In-Utero Environment on on Schooling Outcomes by Age 18

Dependent variable	Did not repeat 6-12th grade		Dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation units	
	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)	Older Cohort for Baseline Sample	Two Years Cohorts - Only Comparison Groups (A and B)
	May 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992	June 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992	June 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992	June 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992	June 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992	June 1990 - February 1991	May 1990 - February 1991 May 1991 - February 1992
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
First Trimester	0.038	-0.005	0.020	-0.039	0.049	0.101*	0.830	1.897	0.083	0.226	0.426**	0.351
	(0.055)	(0.049)	(0.050)	(0.043)	(0.046)	(0.057)	(1.300)	(1.315)	(0.179)	(0.185)	(0.205)	(0.244)
Second Trimester	-0.010	-0.053	-0.033	-0.082*	0.031	0.086	1.274	0.284	0.181	0.156	0.297	0.137
	(0.047)	(0.053)	(0.040)	(0.049)	(0.049)	(0.057)	(1.244)	(1.371)	(0.166)	(0.177)	(0.212)	(0.231)
Number of students	391	1,403	391	1,403	391	1,403	391	1,403	391	1,403	391	1,403

Notes: Standard errors presented in parenthesis are cluster at week of birth. Each Colum is from different regression. Controls includes both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality in Israel, birth order and dummy for twins.

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

Table 6: Estimated Effect of In-Utero Environment on Schooling Outcomes by Age 18 by Gender

Dependent variable	Did not repeat 6-12th grade		Did not dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation units	
	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)
	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	Jun 91 - Feb 92	Jun 90 - Feb 91 Jun 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Boys												
Mean of Dependent variable	0.738	0.729	0.786	0.780	0.214	0.221	9.052	9.979	1.042	1.020	1.553	1.573
First Trimester	0.054	0.039	0.038	0.045	0.074	-0.009	2.170	0.646	0.287	0.155	0.299	-0.082
	(0.075)	(0.046)	(0.066)	(0.050)	(0.061)	(0.063)	(1.314)	(0.973)	(0.192)	(0.158)	(0.215)	(0.124)
Second Trimester	-0.004	-0.023	0.003	-0.011	0.020	-0.052*	1.117	-0.132	0.212	0.119	0.096	-0.156
	(0.068)	(0.049)	(0.056)	(0.037)	(0.053)	(0.028)	(1.291)	(0.721)	(0.204)	(0.108)	(0.165)	(0.167)
F test for (p-value): First Trimester = Second Trimester	0.308	0.181	0.507	0.130	0.334	0.470	0.332	0.440	0.670	0.783	0.317	0.567
Number of students	309	1223	309	1223	309	1223	309	1223	309	1223	309	1223
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	0.187***	0.199***	0.101**	0.100**	0.202*	0.171*	4.890***	4.742***	0.655***	0.709***	0.809***	0.739**
	(0.041)	(0.028)	(0.041)	(0.045)	(0.077)	(0.084)	(1.637)	(1.310)	(0.239)	(0.216)	(0.274)	(0.275)
Second Trimester	0.111**	0.089**	0.049	0.033	0.116	0.077	3.641**	2.717*	0.423*	0.271	0.655***	0.544*
	(0.044)	(0.035)	(0.042)	(0.048)	(0.082)	(0.089)	(1.504)	(1.409)	(0.231)	(0.214)	(0.217)	(0.273)
F test for (p-value): First Trimester = Second Trimester	0.028	0.012	0.144	0.171	0.236	0.214	0.392	0.093	0.250	0.015	0.528	0.328
Number of students	285	1165	285	1165	285	1165	285	1165	285	1165	285	1165
P-Value for difference in the coefficient between boys and girls												
P-value for First Trimester	0.628	0.292	0.860	0.936	0.971	0.263	0.846	0.134	0.854	0.382	0.662	0.019
P-value for Second Trimester	0.420	0.149	0.705	0.467	0.665	0.120	0.621	0.177	1.000	0.929	0.240	0.069

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy for the OLS regressions and at month of birth for the DID regressions. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992 and the two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.
*Significant at 10%; **significant at 5%; ***significant at 1%

Table 7: Estimated Effect of In-Utero Environment on Schooling Outcomes by Mother Education

Dependent variable	Did not repeat 6-12th grade		Did not dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation units	
	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)
	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92
	(1)	(2)	(3)	(4)	(1)	(2)	(5)	(6)	(7)	(8)	(9)	(10)
Mothers have no Education												
Mean of Dependent variable	0.798	0.796	0.848	0.847	0.301	0.301	11.11	11.54	1.196	1.283	1.903	1.922
First Trimester	0.166***	0.152***	0.099*	0.095***	0.105*	0.045	2.955**	2.244**	0.349*	0.278**	0.504**	0.346*
	(0.050)	(0.024)	(0.052)	(0.032)	(0.056)	(0.036)	(1.266)	(0.852)	(0.197)	(0.107)	(0.190)	(0.170)
Second Trimester	0.104**	0.052	0.066	0.036	0.062	-0.008	2.123	0.559	0.193	0.084	0.396**	0.100
	(0.049)	(0.044)	(0.049)	(0.034)	(0.065)	(0.053)	(1.370)	(1.018)	(0.225)	(0.139)	(0.193)	(0.210)
F test for (p-value): First Trimester = Second Trimester	0.124	0.023	0.405	0.020	0.454	0.383	0.502	0.190	0.476	0.249	0.551	0.255
Number of students	382	1416	382	1416	382	1416	382	1416	382	1416	348	1141
Mothers have some Education												
Mean of Dependent variable	0.821	0.830	0.859	0.864	0.311	0.344	12.41	12.61	1.420	1.425	2.113	2.266
First Trimester	0.004	0.031	0.007	0.019	0.106	0.121	2.982	3.060	0.506*	0.623**	0.393	0.300
	(0.055)	(0.037)	(0.055)	(0.047)	(0.092)	(0.097)	(2.010)	(1.918)	(0.269)	(0.252)	(0.361)	(0.447)
Second Trimester	-0.051	-0.049	-0.050	-0.055	0.050	0.006	1.835	1.179	0.408	0.229	0.256	0.163
	(0.063)	(0.048)	(0.053)	(0.061)	(0.081)	(0.090)	(1.705)	(1.975)	(0.258)	(0.276)	(0.247)	(0.436)
F test for (p-value): First Trimester = Second Trimester	0.315	0.046	0.275	0.151	0.431	0.106	0.499	0.060	0.640	0.015	0.648	0.576
Number of students	212	972	212	972	212	972	212	972	246	1241	246	1241

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy for the OLS regressions and at month of birth for the DID regressions. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992 and the two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.

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

Table 8: Estimated Effect of In-Utero Environment on Schooling Outcomes by Mother Education - Only Girls

Dependent variable	Did not repeat 6-12th grade		Did not dropped out of high school before completing 12th grade		Obtained a matriculation diploma		Total matriculation units		Math matriculation units		English matriculation units	
	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)
	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92
	(1)	(2)	(3)	(4)	(1)	(2)	(5)	(6)	(7)	(8)	(9)	(10)
						Mothers have no Education						
Mean of Dependent variable	0.861	0.884	0.906	0.926	0.417	0.407	14.756	15.040	1.489	1.630	2.489	2.470
First Trimester	0.225***	0.249***	0.108*	0.105*	0.118	0.098	3.222	2.402*	0.437	0.389	0.545*	0.560**
	(0.059)	(0.049)	(0.057)	(0.052)	(0.096)	(0.061)	(1.941)	(1.253)	(0.286)	(0.229)	(0.308)	(0.265)
Second Trimester	0.171***	0.128**	0.073	0.046	0.081	0.038	3.342*	1.191	0.244	0.054	0.622**	0.369
	(0.060)	(0.059)	(0.048)	(0.046)	(0.103)	(0.089)	(1.971)	(1.538)	(0.257)	(0.231)	(0.303)	(0.292)
F test for (p-value): First Trimester = Second Trimester	0.319	0.002	0.522	0.210	0.586	0.512	0.948	0.414	0.467	0.150	0.810	0.320
Number of students	180	673	180	673	180	673	180	673	180	673	180	673
						Mothers have some Education						
Mean of Dependent variable	0.914	0.911	0.933	0.939	0.381	0.439	13.571	15.240	1.600	1.742	2.352	2.720
First Trimester	0.093	0.139***	0.060	0.109*	0.202	0.306	6.048*	9.283***	0.740	1.268**	1.069*	1.390**
	(0.061)	(0.046)	(0.057)	(0.055)	(0.169)	(0.179)	(3.237)	(2.814)	(0.466)	(0.458)	(0.531)	(0.566)
Second Trimester	-0.012	0.016	-0.040	0.005	0.111	0.132	1.858	4.564	0.292	0.461	0.587	0.906
	(0.078)	(0.071)	(0.081)	(0.083)	(0.142)	(0.166)	(2.662)	(3.333)	(0.392)	(0.525)	(0.400)	(0.561)
F test for (p-value): First Trimester = Second Trimester	0.074	0.079	0.066	0.143	0.526	0.204	0.100	0.014	0.165	0.022	0.283	0.172
Number of students	105	492	105	492	105	492	105	492	105	492	105	492

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy for the OLS regressions and at month of birth for the DID regressions. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992 and the two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.
*Significant at 10%; **significant at 5%; ***significant at 1%

Table 9: Estimated Effect of In-Utero Environment on Birth Outcomes

Dependent variable	Birth weight				Low birth weight (<2500 gr)				Very low birth weight (<1500 gr)			
	Immigrated on "Operation Solomon" - The Baseline Sample (OLS)		Immigrated on "Operation Solomon" and 2nd generation "Operation Moses" immigrants (DID)		Immigrated on "Operation Solomon" - The Baseline Sample (OLS)		Immigrated on "Operation Solomon" and 2nd generation "Operation Moses" immigrants (DID)		Immigrated on "Operation Solomon" - The Baseline Sample (OLS)		Immigrated on "Operation Solomon" and 2nd generation "Operation Moses" immigrants (DID)	
	May 91 - Feb 92		May 91 - Feb 92		May 91 - Feb 92		May 91 - Feb 92		May 91 - Feb 92		May 91 - Feb 92	
	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)
							All					
Mean of Dependent variable	3068		3082		0.110		0.110		0.005		0.011	
First Trimester	59.585	99.295**	40.260	41.448	0.021	-0.016	0.054	0.043	-0.006	-0.008	-0.016	-0.016
	(62.319)	(46.873)	(72.607)	(60.392)	(0.039)	(0.033)	(0.048)	(0.036)	(0.006)	(0.007)	(0.012)	(0.012)
Second Trimester	106.506*	107.872**	81.766	56.883	-0.024	-0.031	-0.034	-0.028	0.002	0.002	-0.019	-0.019
	(61.597)	(50.300)	(83.799)	(70.640)	(0.037)	(0.028)	(0.044)	(0.037)	(0.008)	(0.007)	(0.012)	(0.012)
Number of students	584		1,045		584		1,045		584		1,045	
							Boys					
Mean of Dependent variable	3106		3112		0.109		0.117		0		0.009	
First Trimester	42.514	100.771	9.936	31.421	-0.002	-0.056	0.031	0.011	-	-	-0.017	-0.027
	(91.565)	(72.847)	(109.826)	(103.296)	(0.063)	(0.051)	(0.065)	(0.052)	-	-	(0.015)	(0.017)
Second Trimester	168.467*	188.400**	222.399**	204.124**	-0.064	-0.076*	-0.092	-0.076	-	-	-0.044**	-0.045**
	(91.447)	(71.192)	(95.143)	(85.439)	(0.061)	(0.044)	(0.062)	(0.055)	-	-	(0.018)	(0.020)
Number of students	303		531		303		531		303		531	
							Girls					
	3026		3051		0.110		0.103		0.011		0.012	
First Trimester	77.625	97.509	56.129	46.487	0.050	0.031	0.103*	0.092	-0.013	-0.015	-0.014	-0.010
	(62.655)	(71.560)	(89.307)	(92.978)	(0.049)	(0.048)	(0.058)	(0.057)	(0.013)	(0.016)	(0.019)	(0.018)
Second Trimester	42.799	35.927	-87.407	-110.654	0.020	0.012	0.050	0.049	0.004	0.004	-0.002	0.003
	(59.989)	(62.408)	(96.132)	(93.264)	(0.041)	(0.043)	(0.045)	(0.050)	(0.017)	(0.017)	(0.024)	(0.021)
Number of students	281		514		281		514		281		514	

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy for the OLS regressions and at month of birth for the DID regressions. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992 and the two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.

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

Table 10: Estimated Effect of In-Utero Environment on High School Quality

Dependent variable	Matriculation diploma rate for the years 2003-2005		Mean total matriculation units for the years 2003-2005		Mean math matriculation units for the years 2003-2005		Mean matriculation test scores for the years 2003-2005	
	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)	The Baseline Sample (OLS)	Two Years Cohorts Sample (DID)
	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92	May 91 - Feb 92	May 90 - Feb 91 May 91 - Feb 92
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First Trimester	-0.004	-0.034	0.090	-0.262	-0.016	-0.069	-0.377	-0.341
	(0.024)	(0.024)	(0.554)	(0.585)	(0.054)	(0.051)	(0.867)	(1.022)
Second Trimester	-0.003	-0.010	-0.193	-0.211	-0.012	-0.052	-0.762	-0.866
	(0.022)	(0.022)	(0.465)	(0.459)	(0.043)	(0.044)	(0.667)	(0.878)
Number of students	594	2,388	594	2,388	594	2,388	594	2,388

Notes: Standard errors presented in parenthesis are cluster at week of pregnancy for the OLS regressions and at month of birth for the DID regressions. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy, mother age at birth, parents age gap, SES of first locality. The Baseline sample includes cohort born between May 27th 1991 and February 15th 1992 and the two years cohorts sample includes cohort born between May 27th 1991 and February 15th 1992 and cohort born between May 27th 1990 and February 15th 1991.

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

Table 11: Potential Longer Term Returns

Dependent variable	Post-secondary education	University	Annual wage (2012)
	(1)	(2)	(3)
Matriculation Diploma	0.217***	0.116*	4782.4**
	(0.026)	(0.017)	(2304.6)
Matriculation Units	0.016***	0.004***	376.9***
	(0.001)	(0.001)	(105.6)
Advance Math (5 units)	0.171	0.134***	6824.7
	(0.024)	(0.039)	(4636.3)
Number of observations	1,115	1,115	1,115

Notes: Standard errors presented in parenthesis are clustered at month of birth. Each Colum is from different regression. All specifications includes also both parents' years of schooling (0 if unknown and a dummy for whether the parents' education is unknown), gender dummy and

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