

IMMIGRATING TO OPPORTUNITY: ESTIMATING THE EFFECT OF SCHOOL QUALITY USING A NATURAL EXPERIMENT ON ETHIOPIANS IN ISRAEL*

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In May 1991 fifteen thousand Ethiopian Jews were brought to Israel in an overnight airlift and sorted in a haphazard and essentially random fashion to absorption centers across the country. This quasi-random assignment produced a natural experiment whereby the initial schooling environment of Ethiopian children can be considered exogenous to their family background and parental decisions. We examine the extent to which the initial elementary school environment affected the high school outcomes of Ethiopian children, using administrative panel data on the educational career of each child in Israel through much of the 1990s. The results show that the early schooling environment has an important effect on high school dropout rates, repetition rates, and the passing rate on matriculation exams necessary to enter college. The results are robust to using alternative measures of the schooling environment and to the inclusion of community fixed effects, which suggests that aspects of the elementary school itself are important for high school success.

I. INTRODUCTION

How important is the environment faced by a young child—her family, her school, her teachers, her peers—in shaping her future outcomes? This is one of the central questions in the social sciences, yet providing a convincing answer has proved elusive, mainly because it is very difficult (and in most cases ethically unjustifiable) to create the ideal laboratory conditions necessary to analyze the matter. Yet sometimes nature, institutions, and political circumstances provide us with the means to address these crucial issues by way of a natural experiment. The sudden exodus of Ethiopian Jews to Israel in May 1991 during “Operation Solomon” represents such a natural experiment.

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In the span of 36 hours, fifteen thousand Ethiopian immigrants were airlifted to Israel and were subsequently distributed into various absorption centers throughout the country. All available evidence suggests that the sorting of immigrants across the country occurred in an essentially random manner. This random sorting process created variation in the school placement of Ethiopian children, which was uncorrelated with the choices and family background characteristics of the children and their parents. In other words, some children ended up attending schools in wealthy Jerusalem suburbs, while others were less fortunate and were relegated to low socioeconomic status development towns, far from the economic and cultural center of the country.

In this paper we exploit the random assignment of immigrants to absorption centers to examine how the elementary school environment affected the long-term achievements of Ethiopian students in their high school years. The natural experiment provided by Operation Solomon allows us to avoid the typical difficulties posed by a nonrandom selection of students into schools, which prevent researchers from identifying separately the effects of family background and the educational environment on student achievements.

Using panel data on a sample of Ethiopian children, we are able to track where Ethiopian children went to elementary school and follow them throughout their high school years. We measure the quality of the elementary school environment faced by Ethiopian children using the average scores on standardized mathematics and Hebrew tests a year prior to the wave of Ethiopian immigration. These variables are exogenous to the influx of Ethiopians into the school system, since they are measured just before the sudden and unexpected immigration wave. With this exogenous variation, we test whether the elementary school environment is related to several different outcomes four to seven years later, when the students are supposed to be in high school. The particular outcomes we measure include the quality of the high school attended, dropping out at various stages in high school, advancing to various stages in high school without repeating a grade, and passing the all-important matriculation exams necessary to attend university.

The results show that attending an elementary school with high pre-immigration math scores reduces the chances of a student dropping out of high school by 4 percentage points relative to an average dropout rate of 10 percent, and increases the passing

rates on high school matriculation exams by 8.2 percentage points relative to an average of 27 percent. In contrast, we find that attending elementary schools with high verbal scores has no effect on most of the high school outcomes. We conjecture that this is due to Ethiopian immigrants learning Hebrew in separate classes and with inexperienced teachers, so that the quality of a school's verbal program for regular students was inconsequential to an Ethiopian student's later scholastic achievement.

We assess the robustness of our results by studying whether high school outcomes are explained by alternative measures of the elementary school environment instead of the average math scores of the school. In particular, we find that high school achievements are significantly related to community characteristics such as income per capita, the welfare rate, and the average passing rate on the matriculation exams. Furthermore, the results using the average math scores of the elementary school are found to be robust to including observable measures of the schooling environment, such as the socioeconomic index of the students, and to the inclusion of community level fixed effects. Overall, these results point to the importance of the early schooling environment, and suggest that aspects of the elementary school itself may be a key factor in determining high school success.

By looking at how the elementary school environment affects outcomes in high school, this paper contributes to the debate over whether investments in the early stages of a child's development have long-term payoffs. Heckman [2000] argues that early investments in human capital for children have a larger payoff than interventions at a later stage, which aim to close the gap between troubled students and regular students. Some evidence for this claim has been found by Krueger and Whitmore [2001], Currie [2001], and Garces, Thomas, and Currie [2002]. Our analysis is also related to the literature on the role of the environment and peer effects in the creation of human capital.¹ Katz, Kling, and Liebman [2001], Oreopoulos [2003], and Edin, Fredriksson, and Åslund [2003] have studied the effect of neighborhood quality on

1. This literature examines whether students benefit from being in contact with better students [Arnott and Rowse 1987; Sacerdote 2001; Zimmerman 2003], whether neighborhood characteristics affect labor market outcomes [Weinberg, Reagan, and Yankow 2004], or whether living in a housing project affects student outcomes [Jacob forthcoming]. This issue has also guided other researchers, who have looked at whether desegregation policies in the United States (such as busing) help or hurt the achievements of blacks and whites [Hoxby 2000a; Angrist and Lang 2002; Hanushek, Kain, and Rivkin 2002].

a broad range of individual outcomes. Their studies use random variation in the neighborhood placement of households to analyze the short-run and long-run effects on labor market outcomes, health, criminal activity, and behavioral problems. Our analysis uses a similar estimation strategy, since we exploit the random placement of Ethiopian families across Israel for our identification purposes, but our focus is on the long-term effects of the early schooling environment on achievements in high school. Finally, our research is related to the literature on the effects of school inputs on student success,² but our paper differs by focusing on school performance, rather than measured inputs, as an indicator of the schooling environment.

The remainder of the paper is organized as follows. The next section presents the historical background that preceded the exodus of Ethiopian Jews to Israel in May 1991, and describes in detail the “epic” story behind Operation Solomon. It also provides anecdotal evidence on how the new immigrants were sorted into housing and schools in a random fashion. Section III describes the data and the empirical strategy. Section IV tests for whether the data accord with the random placement of Ethiopian children into schools, as described in Section II. Section V presents the empirical estimates of the effect of the elementary school environment on a variety of high school outcomes, and Section VI discusses the magnitude of the effects. Section VII concludes the paper.

II. OPERATION SOLOMON: THE CASE FOR A NATURAL EXPERIMENT

II.A. *Historical Background*³

Ethiopian Jews, who sometimes refer to themselves as *Beta Israel* (“House of Israel”), claim to be the descendants of Menelik I, king of Ethiopia, son of the biblical King Solomon and the Queen of Sheba. While there is much debate as to the historical veracity of these claims, there is little controversy as to the fact that a community that identified itself as Jewish has lived in the

2. Recent work has investigated the effects of class size on student achievement, using data from both randomized [Krueger 1999; Krueger and Whitmore 2001], and natural experiments [Angrist and Lavy 1999; Hoxby 2000b]; the effects of class size and teacher quality on the economic returns to schooling [Card and Krueger 1992; Betts 1995]; the effects of teacher training and computers on pupil learning [Angrist and Lavy 2001, 2002]; and the effect of teacher incentives on student achievement [Lavy 2002, 2003].

3. This section is based on Kaplan [1992] and Wagaw [1993].

region of Northern Ethiopia around Lake Tana for several centuries. Throughout most of their history, Ethiopian Jews had no contact with or knowledge of the rest of the Jewish world. Only around the nineteenth century did the existence of a community of black Jews in the heart of Africa arouse the interest of Christian missionaries and of European Jews, concerned with the survival of the *Beta Israel*. In 1867 Joseph Halevy was the first practicing European Jew to visit Ethiopia: his student Jacques Faitlovitch, who first visited Ethiopia in 1904, dedicated his life to the reintegration of the *Beta Israel* to the mainstream of Jewish life.

No attempt was made to bring the Ethiopians to Israel when the State was created in 1948. The first Israeli governments, together with North American Jewish groups, did provide some assistance for educational and health-care programs throughout the 1960s, but it was only starting in the late 1970s that the Likud-led government of Menachem Begin began to pursue a more positive attitude toward Ethiopian immigration. An important role in this change was the 1973 ruling of Israel's Sephardic chief rabbi, Ovadia Yosef, that the *Beta Israel* were in fact descendants of one of Israel's lost tribes, and were therefore entitled to migrate to Israel as full citizens under the Law of Return. This ruling was backed two years later by Israel's Ashkenazi chief rabbi, and transformed into law on April 25, 1975. Thus, Israel had become a viable home for those Ethiopian Jews who were willing to migrate. At roughly the same time, two other factors contributed to increase the push for migration: (1) the drought and consequent famine in Ethiopia, which became increasingly acute after 1973, and (2) the deposition of emperor Haile Selassie in 1974 and the installation of a Marxist-Leninist military junta led by Colonel Mengistu Haile Mariam, which led to a period of civil strife in Ethiopia. As a result, between 1977 and 1984, 7000 Ethiopian Jews migrated to Israel, and 6500 arrived via Sudanese refugee camps between November 1984 and January 1995 ("Operation Moses"). News of this operation leaked to the press, embarrassing the Ethiopian and Sudanese governments, and the venture was brought to an abrupt halt, leaving many Ethiopians stranded in Sudan, and the bulk of the *Beta Israel* (approximately 20,000–30,000 people) still in Ethiopia.

After 1985, a trickle of immigrants continued to arrive in Israel, mostly on a family reunification basis. After the resumption of diplomatic relations between Israel and Ethiopia in 1989,

Ethiopian Jews began to emigrate to Israel in greater numbers: around 5000 Ethiopians arrived in 1990, while some twenty thousand had moved from the Gondar region to Addis Ababa, where they were placed in a temporary camp in the Israeli Embassy compound. At this time, Israel was planning to complete the exodus of the *Beta Israel* within two years in an orderly manner: the relatively small number of monthly departures would enable Israel to portray the operation as a limited family reunification plan, avoiding the suspicions of the Ethiopian population and the international community. However, military events in Ethiopia were overtaking political plans. In March 1991 it became common knowledge that the anti-Mengistu rebels were making steady gains in their struggle against government forces, and foreign residents in Addis Ababa were told by their embassies to leave the country. On May 21, 1991, Mengistu resigned the presidency and fled the country for Zimbabwe. On Friday May 24, minutes before the rebels took over Addis Ababa, the emergency rescue of Ethiopian Jews was underway.

During 36 hours between May 24 and May 25, 1991, over fourteen thousand Ethiopian Jews were airlifted to Israel in "Operation Solomon." Thirty-three aircrafts were used in the course of the operation. One of the Boeing 747 aircraft set a world capacity record when 1,180 passengers somehow found space on a plane built for 400. The Boeing 707s carried up to 500 passengers. In all, 40 round-trips were flown from Tel Aviv to Addis Ababa. During one 30-minute period late Friday night, no less than 2,900 immigrants arrived in Tel Aviv [*The Jerusalem Post*, May 31, 1991].

The day-and-a-half journey that started in the streets of Addis Ababa and ended in temporary housing locations in Israel determined the schools the immigrants' children would attend just a month later. We will claim below that the course of events in this brief journey led to a random assignment of pupils to schools in Israel.

II.B. Randomness in the Airlift from Addis Ababa to Tel Aviv

The call for Jews to assemble at the Israeli Embassy compound was issued at dawn, May 24. The initial trickle quickly became a flood, as Jews streamed in from the four neighborhoods in which they had been living in rented quarters. "After passing through the checkpoints, the immigrants were led aboard buses which transported them some 15 kilometers to the military wing

of Addis Ababa's airport. The immigrants were not allowed to carry with them any belongings and they left behind all their bags and luggage, both for security reasons and because every inch of space on the planes was needed" [*The Jerusalem Post*, May 22, 1992]. This and other casual evidence suggest that the scene at the embassy compound was one of chaos, where thousands of people were trying to make their way to the buses without order, without a pre-prepared list of evacuees and without any rules of boarding priority.⁴ Zimna Berhane, an Ethiopian-born Jewish Agency official who was the main organizer of the Ethiopian Jews living in the Embassy compound, said that "all of Addis was there, and that the scene was reminiscent of Saigon in the days before its fall to the communists" [*The Jerusalem Post*, May 26, 1991].⁵

This description of events at the embassy suggests that the boarding of buses at the embassy did not take place according to any particular order. This fact is important for our study because the random order of boarding the buses also determined the order in which immigrants boarded planes, the timing of landing in Tel Aviv, the order in which they were bused out of the airport in Tel Aviv and the specific absorption center they were sent to. However, even though the initial randomness was triggered in the embassy compound in Addis Ababa, additional chaos and random groupings of the immigrants were added along the way.

The embassy staff was under orders to keep up a sufficient flow of evacuees to the airport so that there would always be a reserve at the airport to fill planes as quickly as they landed [*The Jerusalem Post*, May 26, 1991]. Yet, the boarding process at the airport was initially difficult as evident from the following quote from an Israeli soldier whose job was to escort the busloads to the planes in Addis: "At first the soldiers asked their charges to come forward in small, manageable groups as they prepared to approach the planes. It didn't work. When we asked a few to stand up, they all stood up, hundreds. Then we'd ask them to sit down

4. Micha Feldman, a Jewish Agency official who helped oversee Operation Solomon recalls: "There was no order, and as word of the operation spread, thousands of Ethiopian Jews and their neighbors, swarmed to the embassy compound. We weren't able to move. We couldn't register anyone as hundreds of non-Jews came to watch the show. We couldn't get people into the embassy and on the buses because thousands of people were in the way. I gave the order to my people to use force to clear the path" [*The Jerusalem Post*, September 22, 1991].

5. There is also evidence that many non-Jewish Ethiopians asked or tried to board the buses and planes.

again, and without a word, boom, down they sat. Finally someone had the idea to take a rope, just a simple rope, and cordon off about 40 people. Then we'd ask only these to come with us, toward the plane. Worked like magic" [*The Jerusalem Post*, May 31, 1991].

II.C. The Placement in Absorption Centers

With the landing of each plane in Tel Aviv, several buses pulled out from a parking lot inside the airfield where 250 other buses were waiting, picked up the newcomers, and took them to absorption centers. The Jewish Agency had opened 40 "emergency absorption centers" in hotels and caravans to supplement its existing 50 absorption centers in order to make room for the immigrants [*The Jerusalem Post*, May 26, 1991]. The newcomers were taken to absorption centers as far away as Eilat in the south or Kiriat Shmona in the north.⁶ Many of those placed in hotels were moved within a few months in groups to caravan parks that were set up, in most cases nearby, as a solution to the overcrowding in the hotels that served as the Ethiopian immigrants' first homes in Israel.⁷

The immigrants were placed into absorption centers in order of their arrival, and there is plenty of evidence to suggest that they could not affect the place they were sent to. Even those who had close relatives (children or parents) in Israel did not get to be placed near them.⁸ Nor could the relatives already

6. The majority of the immigrants, over 7,000, were sent to centers in the north, 3,000 to Jerusalem and the southern region, and around 1,000 to the Tel Aviv area. Tiberias was the city that absorbed the largest number of Ethiopian immigrants, some 2,200, followed by Jerusalem with 1,800, Ashkelon with 1,200, and Nahariya with 1,000 [*The Jerusalem Post*, Friday, May 31, 1991].

7. "Because of the pressing need to move large numbers of people out of hotels quickly, the caravan sites were established all over the country, whether or not employment opportunities existed in those areas" (A quote from an article by Sue-Fischkoff who interviewed Ya'acov Babu, spokesman for the United Organization of Jews from Ethiopia [*The Jerusalem Post*, May 22, 1991]). An example is the story of some 1,400 immigrants who were placed at the Diplomat Hotel in Jerusalem, the highest number in any one hotel in the country. By December 1991 all of them were placed in mobile homes sites all over the country [*The Jerusalem Post*, December 20, 1991].

8. A typical story is that of Fantu Atrash, 55, who arrived during Operation Solomon from a village in the Gondar region. Atrash had many relatives in Netanya, Tiberias, and Ashkelon, all from the same region in Gondar, but she was placed in Safed in the north of Israel even though she would have liked to be near her relatives. [*The Jerusalem Post*, August 23, 1992]. Another story is that of Dessta Tadla, a single mother of five children, who was also placed in Safed although she would have preferred to live near her uncle in Rishon Lezion [*The Jerusalem Post*, August 23, 1992].

in Israel influence the placement outcome of their immigrant relatives.⁹

The immigrants of Operation Solomon remained in mobile home camps much longer than the government initially planned. The Shamir government's initial target date of July 1993 to complete the move to permanent housing was abandoned, as the new Rabin government in 1992 abrogated all commitments that had been previously made to the Ethiopians [Kaplan and Rosen 1994, page 83]. In early 1993 the government announced that it would take three to four years before all of the caravan sites could be evacuated.¹⁰ The length of stay in the initial housing has direct bearing on the main issue analyzed in this paper, the effect of elementary school quality on later schooling outcomes, because it implies that pupils who enrolled in September 1991 remained in the same school for an average period of at least 3–4 years.

II.D. The Placement in Schools

The Ministry of Education and the absorption authorities decided to place elementary school pupils in neighborhood schools, or in the nearest religious schools. This policy was stated publicly by the Ministry director general just before the 1991–1992 school year started: “All pupils aged six to 17 will be moved into regular schools on September 1. Elementary school pupils will be studying in schools in their neighborhoods, while pupils aged 12–17 will study in dormitory facilities. Most students, as expected, will be studying in state religious schools, though some will have their classes located in state secular schools, due to a lack of space in the religious institutions. But despite their loca-

9. This is evident from the following quotes: “The Jewish Agency has asked veteran immigrants to not go to the absorption centers looking for relatives until at least Tuesday, so workers will be able to concentrate on finishing the initial absorption of the 14,400 Jews airlifted here in Operation Solomon. Within the next few days, the Agency would come up with a computerized list of newcomers . . . In the meantime, the names and whereabouts of some new arrivals have already begun to be announced on Israel radio's Amharic service each evening . . .” [*The Jerusalem Post*, May 27, 1991]. Even Jewish Agency staffer Ginette Afgas, 29, who had been hoping that her brother, whom she had not seen for eighteen years, would be among the group coming to Hotel Carmeliya, Haifa, found that he had apparently been directed elsewhere, and she had to postpone her eagerly awaited reunion.

10. There is casual evidence suggesting that the stay of Ethiopian immigrants in caravan sites was prolonged by their hesitation to move to permanent housing by buying apartments or houses. Explaining why immigrants seemed hesitant to buy their own homes, a government official said “many Ethiopians have the attitude that the government brought us here, the government will provide us with housing. We won't be thrown out onto the street, so why complicate things with mortgage payments” [*The Jerusalem Post*, February 21, 1992].

tion in secular schools, their studies will be conducted under the auspices of the state-religious system. This is a policy agreed upon by the government, the Jewish agency, and the religious leadership of the Ethiopian community" [*The Jerusalem Post*, August 30, 1991].¹¹ Another piece of evidence revealing the policy to place immigrant students in the nearest religious elementary school is found in a quote from Ora Donio, deputy general manager of the Jewish Agency's immigration department: "While there are no schools in any of the caravan parks, immigrant children walk or are bused to nearby schools outside the sites" [*The Jerusalem Post*, May 22, 1992]. In most schools the Ethiopian pupils were integrated in regular classes, though there were cases of segregated classes for Ethiopians.¹² Moreover, the sorting of Ethiopian children within a given site to different schools also took place in a random fashion. In private conversations held with Rachel Ben-Yitzhak and Lea Shelach, the education coordinators for over 500 Ethiopian children in an absorption center outside the southern city of Ashdod, we were told that it was impossible for schools to select students, and the site administrators made no attempt to sort children based on their educational abilities. Shelach explicitly stated that the sorting of children into schools was "absolutely non-systematic," and it resembled "drawing names out of a hat."

To sum up, there is an abundance of anecdotal evidence suggesting that the initial placement of Ethiopians in absorption centers and schools was as good as random. In the next few sections we describe the data and provide empirical support for what was described above as a random process did indeed lead to an orthogonal relationship between students' background characteristics and the quality of the schools they were assigned to.

11. The decision to place Ethiopian pupils in state religious schools, based on the assumption that it would ease the transition for immigrants from a traditional religious background, was applied not only in elementary schools but in secondary level boarding schools as well. Although parents were permitted to transfer a child to any school after the first year, in practice this seldom occurred [Kaplan and Rosen 1994].

12. The following quote provides evidence on this policy: "In most cases, new immigrants are scattered through the school system, usually without a large enough concentration in individual schools to warrant separate classes. In this situation, the new immigrants are placed in classrooms with veteran Israeli children and have a few hours of separate lessons to help them learn Hebrew. When they are concentrated in large numbers, we can have separate classes for them until they learn enough Hebrew and are ready to be integrated" Tova Azoulay, Ministry of Education and Culture deputy spokesperson [*The Jerusalem Post*, June 1, 1991].

III. DATA AND EMPIRICAL FRAMEWORK

III.A. The Econometric Model

The primary question posed in this paper is whether Ethiopian immigrant children who were placed in a better primary school achieved better high school outcomes. In general, answering such a question is nontrivial due to the nonrandom assignment of children to schools, either because of the choice of schools exercised by children and their parents, or because of the endogenous matching of pupils to schools done by education authorities. These behavioral decisions very often lead to the sorting of pupils to schools by ability and by socioeconomic background. As a result, the observed strong correlation between measured school quality and the scholastic achievements of pupils does not necessarily represent a causal connection.

The unique historical episode represented by Operation Solomon provides an extraordinary opportunity to overcome these estimation problems. The school placement of children from this immigration wave can be thought of as a natural experiment in the sense that it produced variation in the quality of the schooling environment which is exogenous to the characteristics and choices of the students, parents, and policy-makers. Consequently, our empirical strategy is to exploit the essentially random school placement of Ethiopian students in order to identify the causal effect of changing the student's school environment.

Our basic regression model explains the high school outcome of person i who attended elementary school j with the following equation:

$$\begin{aligned} (\text{High School Outcome})_{ij} &= \lambda_0 + \alpha(\text{Elementary School Quality})_j \\ &\quad + \lambda_1(\text{Family Background})_i + u_{ij}. \end{aligned}$$

The quasi randomization of immigrant children to schools guarantees that the key explanatory variable, elementary school quality, is uncorrelated with the residual: thus, the parameter α can be interpreted as causal. Although α is identified without further controls for the person's family background, these additional measures are included in order to reduce the standard errors of the estimates. In addition, since most of the high school outcomes are measured as a binary variable, a probit model is used for estimation. Finally, since school quality does not vary at the

individual level, the standard errors are adjusted for clustering at the elementary school level.

III.B. Data

The analysis uses administrative data from the Israel's Ministry of Education. We have detailed micro data on the universe of Israeli elementary schools in the 1993–1994 school year, the first year a computerized file is available. The data are based on reports from school authorities to the Ministry of Education at the beginning of the school year. The file contains an individual identifier, a school and class identifier, and detailed demographic information on all pupils in grades 1, 2, and 5. We are able to exactly identify pupils of Ethiopian origin who arrived in May 1991 with the information on the country of birth and date of immigration (month and year) of all children and their parents. We focus our attention on the fifth grade cohort (about 70,000 observations in total) in 1993–1994, which was scheduled to finish twelfth grade in the 2000–2001 school year if they had progressed through the system without repetition. Most Israeli elementary schools last through sixth grade, so that an Ethiopian child in this cohort who does not move would spend at least four years in the same elementary school.

We link the elementary school records to individual data on high school enrollment and matriculation exam outcomes in the 1998–1999, 1999–2000, and 2000–2001 school years. We are therefore able to follow each student in the studied cohort from fifth grade throughout the advanced stages of high school. In addition, we were able to collect matriculation exam data for the 2001–2002 school year for the subsample of Ethiopian students who were enrolled in eleventh grade in 2000–2001 (i.e., students who had repeated one grade, and were lagging behind their cohort in the schooling cycle). This allows us to have an almost complete picture of matriculation rates for Ethiopian students. This is particularly important, since passing the high school matriculation exam in Israel is a prerequisite for admission to universities and is one of the most economically important education milestones. Similar high school matriculation exams are found in many countries and in some American states. Examples include the French Baccalaureate, the German Certificate of Maturity (*Reifezeugnis*), the Italian Diploma di Maturità, the New York State Regents examinations, and the recently instituted Massachusetts Comprehensive Assessment System.

III.C. Measuring School Quality

We link the individual longitudinal school histories to data on the quality of the elementary school attended. School quality is measured by the average grades for the fourth and fifth grade students in each elementary school on the math and verbal tests carried out nationally in the 1990–1991 school year.¹³ We use the term “school quality” to represent many relevant features of the schooling environment: the quality of instruction, the quality of one’s peers, the available facilities in and outside the school, the labor market opportunities faced by one’s parents, etc. In addition, we test the robustness of our results by using alternative measures of the schooling environment: the socioeconomic index of the school in 1991, monthly income per capita in the school district in 1991, the average matriculation rate in the school district in 1991, and the welfare rate in the school district in 1991.¹⁴

Using test scores as a measure of school quality has at least two distinct advantages. First, by using test scores from 1990–1991, which is one year before the unexpected mass wave of Ethiopian immigrants, these measures are completely exogenous to the absorption process of Ethiopian children into schools, as required by our empirical strategy. Second, we are able to use student outputs as a direct measure of quality, rather than imperfectly measured school inputs.

III.D. Summary Statistics

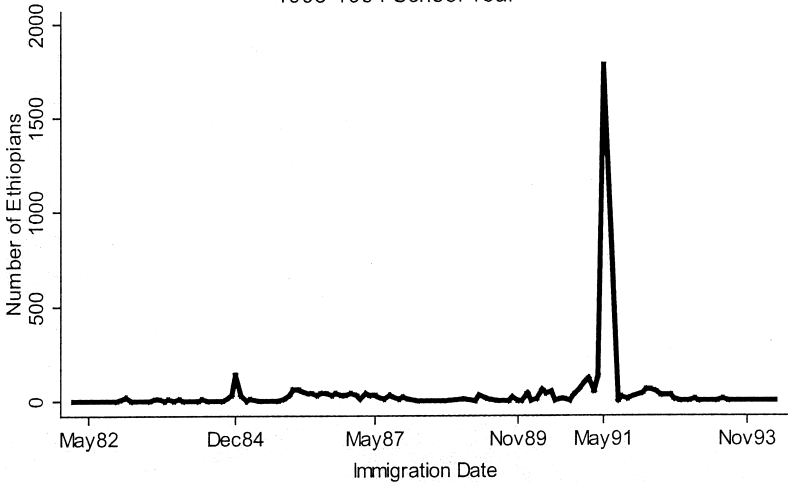
Figure I shows the distribution of Ethiopian children in Israeli elementary schools by immigration date. The figure illustrates the dramatic nature of the May 1991 immigration wave. The number of immigrant children who arrived in May 1991 (1,793 pupils in first, second, and fifth grades) is more than ten times larger than the number of immigrants who arrived in any

13. In June of 1991, near the end of the school year, all fourth and fifth grade students were given achievement tests designed to measure mathematics and Hebrew reading skills. The scores used here consist of the average score on some of the basic and all of the more advanced questions in the test, so that scores are scaled from 1 to 100. The low average and the high variation of scores on this achievement test generated considerable public controversy in Israel, leading to the abandonment of the national testing program in 1992. These are the same data used in Angrist and Lavy [1999].

14. These data were originally collected from a variety of administrative sources by Shitrit and Dor [1994] and Applebaum, Dor, and Heimbarg [1996].

Ethiopian Children in Israeli Schools* by Immigration Date

1993-1994 School Year



*: First, Second, and Fifth Grade in 1993-1994

FIGURE I

Ethiopian Children in Israeli Schools by Immigration Date

other month, and the May 1991 immigrants account for about 40 percent of all Ethiopians in the Israeli school system.

Table I presents summary statistics of the data for our primary sample of Ethiopian students who immigrated in May 1991, and also for three other subsamples of interest: Ethiopians who immigrated in the 1980s, immigrants from the Soviet Union, and the rest of the Israeli Jewish population. Table I also presents the elementary school quality measures discussed above (average scores for the fourth and fifth grade students on the 1991 standardized math and verbal tests), a 1991 socioeconomic index of students in each elementary school¹⁵ (before the Ethiopian immigrants from Operation Solomon were enrolled in Israeli

15. The socioeconomic index is based on a function of the pupils' fathers' education and continent of birth, and of family size. The raw index is recorded as the percentage of students in the school who come from what is defined to be a disadvantaged background. Our socioeconomic status index is obtained by standardizing this variable and multiplying it by -1 , so that high socioeconomic status schools have a high value of the index.

schools), the religious status of each school,¹⁶ and the fraction of Ethiopians in the class.

Table I reveals that Ethiopian immigrants from the 1991 wave typically went to underachieving schools with students of a lower socioeconomic background. This result is not surprising since they were not placed in particularly high-income areas where the best schools are likely to be. However, this result does not violate the crucial exogeneity assumption necessary for identifying the causal effect of the elementary school environment. The random assignment assumption does not require that Ethiopians were placed in a random sample of Israeli schools, but requires only that the distribution of Ethiopians across schools was independent of the Ethiopians' own choices, abilities, and background. Figure II shows that Ethiopians were placed in a sample of schools that closely represents the distribution of schools for all the other students. The figure shows that, although Ethiopians were placed in lower achieving schools on average, the distribution of schools had a very broad and representative range of quality.

Comparing column (1) with columns (2)–(4) in Table I reveals that the May 1991 Ethiopian immigrants went to better schools than the children of Ethiopian families from earlier immigration dates. This reflects the fact that veteran Ethiopians over the years tended to settle into communities with lower housing costs, which also tend to have lower quality schools. This difference illustrates the nature of our natural experiment: due to the chaotic nature of the airlift, some Ethiopian children went to better schools than they would have gone to otherwise.

Ninety-two percent of the Ethiopian fifth graders who immigrated in May 1991 studied in religious schools, higher than the respective proportion among immigrants who arrived in the 1980s (upper panel in Table I). This reflects the official government policy discussed in the previous section. Also important to note is the high average proportion of Ethiopians placed within the same class (32 percent) or grade (27 percent) for the May 1991 immigrants.

The measures of student's family background presented in the second panel of Table I include the education levels of both parents, number of siblings, and age while attending fifth

16. The Israeli public school system includes religious (25 percent) and secular (75 percent) state schools.

TABLE I
SUMMARY STATISTICS

	Ethiopians, immigrated May 1991	Ethiopians, immigrated in 1980s	Former Soviet Union immigrants	Other Jews ^a
Number of students	532	536	5762	55891
Elementary school characteristics				
Math score in 1991, 4th grade	64.42 (9.47)	60.62 (8.76)	67.52 (8.26)	69.60 (7.53)
Math score in 1991, 5th grade	63.04 (9.68)	60.35 (9.50)	65.93 (9.05)	68.19 (8.49)
Verbal score in 1991, 4th grade	67.85 (7.87)	64.55 (8.54)	70.80 (7.59)	73.03 (6.85)
Verbal score in 1991, 5th grade	70.38 (7.52)	68.48 (7.55)	72.97 (7.35)	75.02 (6.60)
1991 socioeconomic index ^b	-1.12 (1.06)	-1.35 (1.29)	0.05 (0.82)	0.20 (0.81)
Religious school	0.92 (.27)	0.86 (0.34)	0.15 (0.36)	0.22 (0.42)
Fraction Ethiopians in class	0.32 (0.28)	0.24 (0.16)	0.015 (0.056)	0.017 (0.057)
Monthly income per capita in school locality, 1991	724.20 (163.75)	777.36 (153.22)	862.08 (192.83)	906.01 (228.18)
Welfare recipients (per thousand people) in school locality, 1991	34.70 (22.99)	47.55 (25.83)	32.82 (23.15)	28.64 (22.24)
Percent passing matriculation exams in school locality, 1992-1993	38.61 (11.23)	38.79 (10.38)	44.89 (12.64)	46.76 (13.19)
Personal characteristics				
Father's years of schooling	1.67 (3.24)	2.99 (4.10)	11.43 (5.46)	11.58 (4.27)
Mother's years of schooling	1.27 (2.82)	2.56 (3.81)	12.27 (4.65)	11.70 (4.00)
Number of siblings	4.12 (2.60)	4.21 (2.25)	1.10 (1.17)	2.38 (1.55)
Age in 1994	11.5 (1.23)	11.43 (0.60)	11.43 (0.68)	11.14 (0.39)
High school outcome variables				
Ever attended 10th grade	0.92 (0.26)	0.91 (0.28)	0.86 (0.35)	0.96 (0.20)
Ever attended 11th grade	0.86 (0.34)	0.87 (0.33)	0.82 (0.39)	0.94 (0.24)
Reached 10th grade without repetition	0.67 (0.47)	0.86 (0.35)	0.80 (0.40)	0.94 (0.24)
Reached 11th grade without repetition	0.67 (0.47)	0.82 (0.39)	0.77 (0.42)	0.92 (0.27)
Reached 12th grade without repetition	0.65 (0.48)	0.78 (0.41)	0.74 (0.44)	0.89 (0.31)

TABLE I
CONTINUED

	Ethiopians, immigrated May 1991	Ethiopians, immigrated in 1980s	Former Soviet Union immigrants	Other Jews ^a
High school outcome variables				
Dropped out before completing 12th grade	0.10 (0.30)	0.17 (0.38)	0.22 (0.41)	0.09 (0.27)
Passed high school matriculation exams ^c	0.23 (0.42)	0.29 (0.46)	0.50 (0.50)	0.58 (0.49)
Quality of high school attended ^d	0.44 (0.23)	0.47 (0.23)	0.58 (0.24)	0.63 (0.22)

Entries in the table represent the means of the relevant variables. Standard deviations are in parentheses.

a. Other Jews: Native Israelis not of Ethiopian origin, and immigrants from anywhere except Ethiopia and the Soviet Union.

b. Standardized to have mean 0 and standard deviation 1 in the entire population of schools.

c. As of the end of the 2000–2001 school year.

d. Measured by the average matriculation rate between 1996 and 1998 in the high school attended.

grade.¹⁷ Table I reveals stark differences in levels of parental education between the Ethiopians and the rest of the population. Parents of Ethiopian children typically had one or two years of education, compared with an average of over 11.5 for parents of Israeli Jewish children in fifth grade. These numbers are not unusual for the Ethiopian population—average schooling in Ethiopia for 1990 was one year.

The bottom panel of Table I presents the means for the various measures of high school outcomes: whether or not the student ever attends various grades, whether the student reached a given grade without repeating, whether the student drops out of school before completing twelfth grade, whether the student passed the matriculation exams, and the quality of the high school attended (measured by the average matriculation rate for students in that high school between 1996 and 1998). Not surprisingly, the high school educational outcomes of Ethiopian students are significantly lower than those of their peers for most outcomes. For example, only 23 percent of the Ethiopians passed their matriculation exams by the end of the 2000–2001 school

17. This is calculated from the reported year of birth in the Ministry of Education data. This variable may be problematic since many Ethiopians did not know their exact date of birth, as the Ethiopian calendar differs from that used in the West with regard to both the months and years. However, physical tests were often administered to verify the child's age.

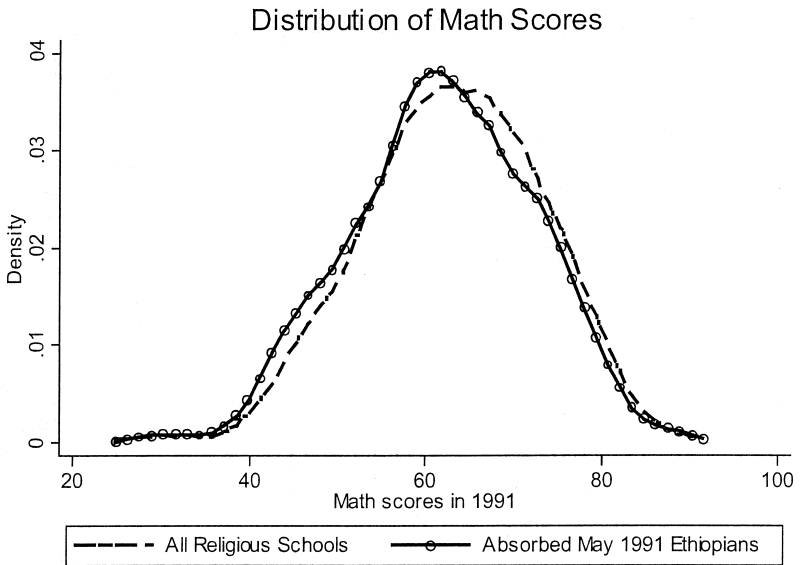


FIGURE II

School Quality of Absorbing Schools versus All Schools

Kernel density estimates of average math scores in 1991 in all schools and in schools that absorbed Ethiopian immigrant children who arrived in May 1991. Religious schools only. The total number of religious schools is 305. The number of religious schools that absorbed Ethiopians is 121.

year compared with 58 percent for Israeli Jews and 50 percent for Russian immigrants.¹⁸

However, there is ample evidence that the main difference between new Ethiopian students and their peers is that Ethiopian children are much more likely to repeat a grade.¹⁹ For example, only 67 percent of the Ethiopian sample made it to tenth grade without repeating a grade compared with 94 percent for Israeli Jews, while 92 percent of the Ethiopians did eventually make it to tenth grade compared with 96 percent for Israeli Jews.

18. We only have data for 2001–2002 for the sample of May 1991 Ethiopians: in the regression analysis we will use the complete data for this sample, while in Table I we restrict the descriptive analysis to the data up to the 2000–2001 school year for the sake of comparability with other sectors of the population. With the 2001–2002 data, the Ethiopians' matriculation rate goes up to 27.4 percent.

19. The relatively low high school achievements of the Russian immigrants, such as only 86 percent ever attending tenth grade, are likely to reflect migration of Russians out of Israel to other countries rather than the true dropout rate. This is not likely to be a problem for Ethiopian immigrants, but comparing outcomes with Russian immigrants may be problematic for this reason.

Similar results are found for twelfth grade: only 10 percent of Ethiopians drop out before completing twelfth grade compared with 9 percent for Israeli Jews; only 65 percent of the Ethiopians reach twelfth grade without repeating a grade, compared with 89 percent for Israeli Jews.²⁰

IV. EMPIRICALLY TESTING FOR RANDOM ASSIGNMENT

In this section we examine whether the data support the anecdotal evidence on the random assignment of Ethiopian Jews into schools. Specifically, we test whether there is a significant relationship between the observable characteristics of Ethiopian children and the type of school they attended. This can be done by estimating regressions of the various measures of the student's elementary school environment on various measures of their family background. If the assignment was indeed random, we would expect to find no significant relationship. This is not necessarily proof of a random assignment, as the assumption requires there to be no correlation between school quality and both observable and *unobservable* background characteristics. However, the lack of a significant relationship between school quality and observable characteristics suggests that it is unlikely that such a relationship exists between school quality and unobservable characteristics. The results of these tests are presented in Table II.

Each coefficient in Table II represents the estimate from a single regression for each of the various measures of the elementary school environment on one of the measures of family background. For example, the first column presents the results of six separate regressions for the six measures of the elementary school environment, when the explanatory variable in each regression is father's years of schooling.

The first column of Table II reveals that father's schooling is not significantly correlated with any of the schooling environment measures. The robust *t*-statistics (adjusted for clustering) reported in parentheses are mostly below 1, indicating essentially no relationship between indicators of school quality and father's education. The second column of Table II indicates that mother's

20. Repeating a grade for Ethiopians is not necessarily as bad a signal about achievements as it is for non-Ethiopians. In fact, repeating a grade after immigration may eventually be more beneficial to an Ethiopian child than being passed along after a marginal performance stemming from problems of adapting to a new language and environment.

TABLE II
TEST OF BALANCING—ETHIOPIANS WHO ARRIVED IN MAY 1991

Elementary school quality measures	Background characteristics				
	Father's years of schooling	Mother's years of schooling	Male	Number of siblings	Age in 1994
Average math score in the school, 1991 ^a	0.005 (0.39)	-0.006 (-0.36)	0.062 (0.74)	-0.050 (-2.42)	0.004 (0.07)
Average verbal score in the school, 1991 ^a	0.006 (0.56)	0.001 (0.09)	0.071 (0.91)	-0.018 (-0.93)	0.031 (0.77)
Socioeconomic index in the school, 1991 ^b	0.022 (1.58)	0.061 (3.44)	0.083 (0.79)	-0.017 (-0.67)	0.063 (1.00)
Monthly income per capita in the school district, 1991	-1.676 (-0.84)	-0.274 (-0.11)	6.380 (0.46)	-8.570 (-2.15)	8.690 (1.14)
Average matriculation rate in the school district, 1992-1993	0.098 (0.81)	0.140 (0.73)	0.412 (0.43)	-0.055 (-0.18)	0.232 (0.37)
Welfare recipients in the school district, 1991 ^{b,c}	0.013 (1.06)	0.008 (0.63)	0.303 (0.38)	-0.031 (-1.51)	0.017 (0.37)

The entries in the table represent the coefficients from separate univariate regressions of the school and locality characteristics variables on the background characteristics. Robust *t*-statistics (adjusted for clustering at the school level) are in parentheses.

a. The average math and verbal scores are the averages of the standardized scores for fourth and fifth grade students in 1991.

b. Standardized to have mean 0 and standard deviation 1.

c. Transformed so that high values of the variable represent good outcomes, i.e., a low welfare reciprocity rate.

schooling is also not correlated with school quality and community measures, although it does seem to be correlated with the socioeconomic index of the students. As for the other three personal characteristics (sex, number of siblings, and age in 1994), they are largely uncorrelated with any of the school quality or community environment measures.²¹ Overall, the results in Table II do not suggest any systematic pattern in the school placement of Ethiopian children according to their family background.

21. The fact that age in 1994 is uncorrelated with measures of school quality suggests that there are no systematic differences between schools in how children of a given age are assigned to a particular grade. Administrators at one caravan site told us that the assignment to a given grade was based primarily on the children's self-reported age; if there was a major discrepancy between a child's reported age and his physical development, the site administrators would conduct a physical test to ascertain the exact age. Schools had no say in allocating children to any specific grade. We also linked children in elementary schools in 1993-1994 and 1994-1995, and we did not find any correlation between grade repetition and school quality among Ethiopian children who were in second grade in 1993-1994.

With only a few exceptions, the *t*-statistics for all the coefficients in Table II are well below 1; only four out of the forty *t*-statistics presented in the table are above the level of marginal significance.

These results support the idea that the Ethiopian immigrants from May 1991 were randomly sorted into schools. It is worth emphasizing that the regressions find no correlation between background characteristics and the quality of schools attended by Ethiopians in the 1993–1994 school year, two full years after Operation Solomon. Contributing factors that helped keep the initial assignment unchanged for a few years is the limited education of the Ethiopian immigrants in combination with their limited understanding of Hebrew and the Israeli bureaucracy, and their hesitation to take out mortgages. Given these obstacles, it is easy to understand why Ethiopian parents had very little involvement in the choice of their child's school in the first few years after their immigration. Naturally, we expect that Ethiopian parents would have gradually learned some Hebrew and learned more about the Israeli education system, so that the placement of children into schools would be less random over time. Table III examines this issue directly by studying whether parental schooling levels are associated with school quality for other samples in the population.²²

The first column in Table III replicates, for ease of comparison, the results from Table II for the May 1991 Ethiopian immigrants. The second and third columns show, respectively, the results for the prior wave of Ethiopian immigrants from the 1980s and for the Russian immigrants who immigrated roughly at the same time as the 1991 Ethiopians. In these two samples, parental education levels are highly correlated with elementary school quality. In addition, the bottom panel of Table III shows that, for all groups, parental background is strongly correlated with school quality as the cohort reaches their high school years. This finding confirms our expectation that educated parents of Ethiopian children learn over time how to place their children into better schools, just like other sectors of the population.

The comparison between the first column and the last three columns in Table III demonstrates just how unusual the sample

22. Table III presents the same tests for balancing for the other subpopulations in Israel only for parental education. For the full listing of the balancing tests for all the school and local characteristics as in Table II, see Gould, Lavy, and Paserman [2003].

TABLE III
TESTS OF BALANCING—OTHER GROUPS

	Ethiopians, immigrated in May 1991	Ethiopians, immigrated in the 1980s	Former Soviet Union immigrants	Other Jews ^a
Average math score in elementary school, 1991				
Father's years of schooling	0.005 (0.39)	0.027 (2.28)	0.012 (3.90)	0.033 (12.73)
Mother's years of schooling	-0.006 (-0.36)	0.035 (2.55)	0.021 (4.38)	0.035 (11.96)
Average verbal score in elementary school, 1991				
Father's years of schooling	0.006 (0.56)	0.027 (2.32)	0.013 (4.25)	0.042 (17.53)
Mother's years of schooling	0.001 (0.09)	0.037 (2.66)	0.021 (4.12)	0.044 (15.95)
Average matriculation rate at high school attended, 1996-1998				
Father's years of schooling	0.010 (3.36)	0.007 (2.35)	0.006 (7.22)	0.013 (22.33)
Mother's years of schooling	0.009 (2.51)	0.008 (2.60)	0.007 (6.47)	0.013 (18.19)

The entries in the table represent the coefficients from separate univariate regressions of the average test scores on the background characteristics. The average test scores are the averages of the standardized scores for fourth and fifth grade students in 1991. Robust *t*-statistics (adjusted for clustering at the school level) are in parentheses.

a. Other Jews: Native Israelis not of Ethiopian origin, pre-1989 Soviet Union immigrants, and all other immigrants from anywhere except Ethiopia and the Soviet Union.

of 1991 Ethiopian immigrants appears to be as of 1993: they are the only subsample that is not strongly sorted into better elementary schools according to parental background, despite displaying very strong sorting later on in their high school years. These findings clearly demonstrate that the apparent "random sorting" into elementary schools is not due to the low mean and variation in education levels of Ethiopian parents, since the same sample of Ethiopians displays strong sorting later on in high school. In addition, this possibility is further refuted by the strong sorting into elementary schools by the prior wave of Ethiopian immigrants (second column), who also had extremely low levels of education. Furthermore, the evidence in favor of random sorting into elementary schools is not due to the fact that the Ethiopians had been in Israel for only a short period, since we do find strong positive sorting for the sample of former Soviet Union immigrants, who arrived at roughly the same time. Finally, the differ-

ences across groups in elementary school cannot be explained by the smaller standard errors for the non-Ethiopian subgroups as a result of much larger sample sizes—since this cannot explain the large differences in the sizes of the coefficients in elementary school (as well as the occasional unexpected negative sign for 1991 Ethiopians).

The last column in Table III shows that average math and verbal scores of primary schools are highly and positively related to the education levels of both parents of native Israeli Jewish children. This result is to be expected since native families have already self-selected themselves into schools according to their family income, educational background, ethnic group, etc. These results point to why it is so difficult to estimate the effect of the schooling environment on the performance of students: it is impossible to know whether this very strong correlation is due to a causal effect or whether it stems from selective sorting.

V. THE EFFECT OF THE ELEMENTARY SCHOOL ENVIRONMENT ON HIGH SCHOOL OUTCOMES

V.A. *Benchmark Specification*

Using the sample of Ethiopian immigrants from the 1991 wave who were in fifth grade in the 1993–1994 school year, Table IV presents the basic results for how measures of the quality of the school environment affected high school outcomes. Columns (1) and (2) use the average math scores for fourth and fifth graders, a year prior to the Ethiopian immigration wave of 1991. Since these tests were not comparable, we aggregated them in two ways. First, we simply standardized them by their mean and standard deviation and computed the simple mean of the standardized variable across the two grades for each elementary school. Second, we take the average percentile rank across grades within each school, since the percentile rank should be a comparable measure of school performance across grades. In column (3) we simply classify schools as good or bad based on whether the school has a “high average percentile rank” (greater than 0.6). Using this dichotomous variable may yield sharper results because it reduces the amount of noise in the data stemming from a rather small sample size and noisy measures of school quality.²³

23. The dichotomous classification of schools can also be viewed as a test of nonlinearity in the effects of school quality. For an extensive exploration of nonlinear effects, see Gould, Lavy, and Paserman [2003].

TABLE IV
THE ELEMENTARY SCHOOL ENVIRONMENT AND HIGH SCHOOL OUTCOMES

	Math scores in 1991			Verbal scores in 1991		
	Standardized score (1)	Average percentile (2)	High average percentile dummy (3)	Standardized score (4)	Average percentile (5)	High average percentile dummy (6)
Ever attended 10th grade	0.015 (2.14)	0.060 (2.15)	0.030 (1.72)	0.020 (2.57)	0.084 (2.29)	0.016 (0.66)
Ever attended 11th grade	0.010 (0.68)	0.067 (1.12)	0.041 (1.17)	0.011 (0.84)	0.066 (1.13)	0.040 (0.95)
Reached 10th grade without repetition	0.022 (0.93)	0.074 (0.75)	0.040 (0.70)	-0.004 (-0.17)	-0.050 (-0.51)	-0.030 (-0.45)
Reached 11th grade without repetition	0.042 (1.74)	0.145 (1.46)	0.097 (1.69)	0.010 (0.44)	0.021 (0.21)	-0.007 (-0.11)
Reached 12th grade without repetition	0.038 (1.61)	0.137 (1.42)	0.090 (1.67)	0.014 (0.63)	0.045 (0.47)	0.008 (0.12)
Dropped out before completing 12th grade	-0.017 (-1.74)	-0.076 (-1.98)	-0.040 (-1.71)	-0.021 (-1.94)	-0.092 (-1.88)	-0.019 (-0.57)
Passed high school matriculation exams	0.009 (0.56)	0.061 (0.95)	0.082 (2.10)	-0.016 (-0.96)	-0.054 (-0.77)	-0.052 (-1.03)
Quality of high school attended ^{a,b}	0.017 (1.58)	0.072 (1.68)	0.067 (2.33)	0.003 (0.29)	0.030 (0.73)	0.017 (0.64)

Table entries represent the marginal effects (evaluated at the average of the independent variables) estimated from separate probit models of the relevant outcome variable on 1991 test scores in the elementary school attended. Robust *z*-statistics (adjusted for clustering at the school level) for the underlying probit coefficients are in parentheses. All regressions also include father's years of schooling, mother's years of schooling, a gender dummy, age in fifth grade, number of siblings (0 if unknown), a dummy for whether the number of siblings is unknown, and a dummy for whether the 1994 school was religious. The high average percentile dummy equals one if the average percentile is above 0.6, and equals zero otherwise. The sample size is 509 children.

a. Measured by the average matriculation rate in between 1996 and 1998 in the high school attended.

b. Coefficient on the 1991 test score from a linear regression model. Robust *t*-statistics are in parentheses. The sample includes only students who ever attended high school (451 observations).

Columns (4) to (6) present a similar analysis using the verbal scores of fourth and fifth graders in each elementary school.

Each entry in Table IV represents a different probit regression. All of the probit regressions control for father's years of

schooling, mother's years of schooling, a gender dummy, age while attending fifth grade, number of siblings (0 if unknown), a dummy for whether the number of siblings is unknown, and a dummy for whether the elementary school was religious. The coefficient in the first row and column (0.015) represents the marginal effect (evaluated at the mean of the explanatory variables) from a probit on whether the student ever attended tenth grade on the elementary school's average standardized math score. This coefficient implies that a one standard deviation change in the average math score of the school leads to a 1.5 percentage point change in the probability of ever attending tenth grade. Considering that only 8 percent of all Ethiopian students do not make it to tenth grade (Table I), a 1.5 percentage point response is quite substantial in magnitude, in addition to being statistically significant.²⁴

Although Table IV reports results from many different probits, several patterns emerge in the analysis. The average standardized math score appears to be significant at the 10 percent level for three of the eight high school outcomes, and marginally insignificant for two additional outcomes. The results are similar, although a little weaker, using the average percentile math score, but generally stronger when using the dichotomous classification of attending an elementary school with a "high average percentile" math score.

The outcomes that tend to be significantly related to math scores are those for ever attending tenth grade, dropping out before completing twelfth grade, quality of high school attended, and to a lesser extent, reaching twelfth grade without repetition. We also find a strong effect of elementary school math scores on the probability of passing the matriculation exams when using the "high average percentile" dummy (moving a child from a "bad" to a "good" school raises the matriculation rate by 8.2 percentage points), but no effect when the average standardized score is entered linearly.

The last three columns of Table IV use verbal scores as the measure of school quality. The results using the average standardized verbal scores and the average percentile score are similar to those using math scores in that they are significant for the

24. If the previous cohort of Ethiopian immigrants, who were disproportionately located in low socioeconomic status towns, were able to influence the placement of their family members from the new cohort, and having a network of relatives increases the chances of success in high school, then our results would be biased against finding any effect of school quality on outcomes.

overall dropout rate and the probability of attending tenth grade. However, all the other coefficients are insignificant, and some even have the unexpected sign. Furthermore, none of the coefficients are significant when we use the high average percentile dummy for verbal scores. Therefore, although Table IV presents some evidence that verbal test scores are related to the dropout rates of Ethiopian children in high school, the results for verbal scores are clearly much less consistent across outcomes than the results for math scores.²⁵

V.B. Explaining the Differences between Math and Verbal Scores

To investigate why the verbal and math results differ, we first examine whether the relationship between high school outcomes and the two different types of tests is also different for other Israeli students, or whether this phenomenon is unique to the Ethiopian sample. The first two columns of Table V replicate columns (3) and (6) of Table IV for the sample of other Israeli fifth graders in 1993–1994 (the sample, shown in column (4) in Table I, includes Israeli Jews but excludes former Soviet Union and older Ethiopian immigrants). We focus on the coefficient on the “high average percentile dummy” mainly for ease of interpretation. For every high school outcome in Table V, the math and verbal score coefficients are nearly identical to each other in magnitude and statistical significance. Although these coefficients should not be interpreted as being causal, since we do not claim that other Israelis were randomly distributed into elementary schools, the results show that there are no differences in the relationship between math and verbal scores with the high school outcomes for other Israelis. These findings suggest that the differential effects of math and verbal scores of the elementary school on the high school outcomes of Ethiopian students are most likely specific to the case of the Ethiopians themselves, rather than something systematic about the two tests which should also show up for other Israelis.²⁶

It is not entirely surprising that the quality of the verbal program in elementary school may have been less relevant for

25. In regressions not reported, we have also found that school quality seems to be somewhat more beneficial for girls than for boys, but the sample sizes are too small to estimate these differences with precision.

26. Interestingly, Currie and Thomas [2001] find that success in reading may be less dependent on school quality than success in mathematics.

TABLE V
ELEMENTARY SCHOOL QUALITY AND HIGH SCHOOL OUTCOMES FOR OTHER ISRAELIS

	High average percentile dummy		High average percentile dummy	
	Math	Verbal	Math	Verbal
Ever attended 10th grade	0.009 (3.90)	0.012 (5.28)	0.003 (1.31)	0.007 (2.56)
Ever attended 11th grade	0.016 (5.58)	0.020 (6.60)	0.006 (1.79)	0.008 (2.30)
Reached 10th grade without repetition	0.011 (3.74)	0.015 (4.91)	0.003 (0.85)	0.007 (1.91)
Reached 11th grade without repetition	0.020 (5.65)	0.024 (6.70)	0.006 (1.61)	0.010 (2.27)
Reached 12th grade without repetition	0.023 (5.48)	0.028 (6.59)	0.009 (1.83)	0.013 (2.70)
Dropped out before completing 12th grade	-0.020 (-5.51)	-0.024 (-6.35)	-0.008 (-2.03)	-0.011 (-2.51)
Passed high school matriculation exams	0.082 (9.45)	0.106 (12.38)	0.042 (4.64)	0.064 (6.61)
Quality of high school attended ^{a,b}	0.094 (13.12)	0.117 (17.22)	0.038 (5.95)	0.054 (8.22)
School and locality characteristics	No	No	Yes	Yes

The entries in the table represent the marginal effects (evaluated at the average of the independent variables) estimated from separate probit models of the relevant outcome variable on a dummy variable equal to 1 if the average math score percentile in the elementary school attended was greater than 0.6. Robust *z*-statistics (adjusted for clustering at the school level) for the underlying probit coefficients are in parentheses. School and locality characteristics include the school's socioeconomic index in 1991, an index of distance from the closest major urban center, income per capita in 1991, percentage receiving welfare in 1991, and average high school matriculation rate in 1991. Sample size: 48,662.

a. Measured by the average matriculation rate in between 1996 and 1998 in the high school attended.

b. Coefficient on the 1991 test score from a linear regression model. Robust *t*-statistics are in parentheses. The sample includes only students who ever attended high school (41,659 observations).

Ethiopian children than the quality of the math program. First, in many elementary schools, Ethiopian students were taught Hebrew in special classes separate from the other Israeli children.²⁷ Second, in cases where the Ethiopian students were taught in separate classes, their teachers were often recent high school graduates performing national service,²⁸ which would ren-

27. In footnote 12 we presented quotes of Ministry of Education officials that indicated that the official policy contemplated language instruction in separate classes.

28. The national service of teaching in religious elementary schools is an option opened only to religious female high school graduates as an alternative to their compulsory military service.

der the verbal quality of the regular program inconsequential for Ethiopians. Third, “after-school” programs aimed at teaching language skills to Ethiopian immigrant children may have diluted the effects of a weak or even a strong verbal program. There is evidence that such programs were indeed offered to the May 1991 immigrant pupils in their schools and at the community level. Finally, it may be the case that Ethiopian students benefited more from a strong math program because their language deficit was less of a problem in learning math skills. All of these factors combined may be the reason why the math and verbal quality of the elementary school is so differentially related to the high school outcomes for Ethiopians, but not for other Israeli students.

V.C. Testing Robustness

Table IV showed that the high school outcomes of the Ethiopian immigrants are related to their elementary school’s average math scores but not verbal scores. This discrepancy may generate some concern about whether it is appropriate to conclude that the effect of the early school environment is significant. One way to assess the robustness of our results is to test whether the math score results are sensitive to the inclusion of additional schooling characteristics. Another way is to see whether other characteristics of the school or the community—which should be correlated with the math scores of the school—are also correlated with high school outcomes.

This analysis is displayed in Table VI, which presents the results using alternative measures of school quality, and checks whether the coefficient on math scores is robust to the inclusion of additional control variables. We focus on explaining the outcome of passing the high school matriculation exams, since this is the most important of our outcome variables, but similar results were found for the other outcomes.

The first column adds the fraction of Ethiopians in the class to the specification in column (3) of Table IV. If high quality schools absorbed fewer Ethiopian immigrants than low quality schools, the estimates in the previous section may be picking up the effect of being in a class or a school with a low number of Ethiopian pupils, rather than other aspects of school quality. However, this scenario is rejected in column (1), which shows that the coefficient on the fraction of Ethiopians in the class is insig-

TABLE VI
ALTERNATIVE MEASURES OF THE SCHOOL ENVIRONMENT

	Dependent variable: Passed high school matriculation exams									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
High math percentile dummy for the school in 1991	0.087 (2.20)					0.068 (1.51)	0.106 (1.80)	0.107 (2.14)		
School socioeconomic index in 1991		0.005 (0.32)				-0.014 (-0.78)	-0.039 (-1.24)			-0.021 (-0.88)
Monthly income per capita (thousands NIS) in school district in 1991			0.220 (1.98)			0.149 (1.15)	0.183 (0.81)			
Average matriculation rate in school district in 1992-1993				0.235 (1.96)		0.043 (0.25)	0.080 (0.22)			
Fraction of population receiving welfare in school district in 1991					-1.361 (-2.04)	-0.815 (-1.01)	-0.742 (-0.53)			
Fraction Ethiopians in class in 1993-1994	0.068 (0.84)	0.057 (0.67)	0.101 (1.15)	0.063 (0.78)	0.016 (0.17)	0.067 (0.65)	0.132 (0.86)	0.147 (1.01)	0.149 (1.01)	
Locality of residence fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	

The entries in columns (1)-(5) represent the marginal effects (evaluated at the average of the independent variables) of the relevant explanatory variable on the probability of passing the high school matriculation exams, estimated from separate probit models. The entries in column (6)-(8) represent the coefficients in a linear probability model. Robust z -statistics (adjusted for clustering at the school level in columns (1), (2), (8), and (9); and at the school district level in the remaining columns) for the underlying probit coefficients are in parentheses. For the list of control variables, see notes to Table IV.

nificant, and the math score coefficient is virtually unchanged in magnitude or precision.²⁹

Columns (2) to (5) replace math scores with four different

29. Instead of the percent of Ethiopians in the class, we have experimented with the percent of Ethiopians in the grade, in the school, and also by including Ethiopians from the previous wave of immigration. In addition, we tried the number of Ethiopian students instead of the percentage. None of these variables affected the coefficient on the math score variable.

measures of the quality of the early schooling environment. Three of these alternative measures turn out to be significant determinants of high school success: income per capita, the average matriculation rate, and the fraction of the population receiving welfare (at the community level). In contrast, the school's socioeconomic index does not seem to influence the probability of passing the matriculation exams. The magnitude of the significant coefficients is similar to that found for math scores. A one standard deviation increase in income per capita (approximately 160 New Israeli Shekels³⁰) raises the probability of passing the matriculation exam by about three and a half percentage points. The fact that three of the four alternative measures of the schooling environment are significant shows that the results for math scores are not unusual. Furthermore, the insignificant coefficient for the socioeconomic index may be due to the fact that schools with a low value for this index receive extra resources from the Israeli government—these extra funds might mitigate any adverse effects of being in a school with a low socioeconomic student body.

Column (6) of Table VI includes all five measures of the school environment simultaneously in the same probit specification. The different measures are highly correlated, which leads to a general loss in precision of the estimates. However, the coefficient on the elementary school math score is still just marginally insignificant, and is only slightly smaller in magnitude than in column (1). On the other hand, all the other coefficients become insignificant, suggesting that the math score is the variable most highly correlated with the environmental factors that are important for high school success.

Column (7) adds fixed effects for the community of residence to the analysis. This column represents the ideal experiment we would want to conduct in order to isolate the effect of school quality from the other neighborhood and community variables.³¹

30. In 1991 the exchange rate was roughly 1 US Dollar = 2.4 New Israeli Shekels.

31. This is the ideal experiment under the assumption that, given the locality of residence, the quality of the school one attends is exogenous to the individual's background characteristics. We have argued that Operation Solomon essentially randomly assigned immigrants across localities. In addition, in conversations held with different education coordinators at caravan sites, we have learned that the allocation of children from a given site to different schools was also essentially random. Schools could not select students based on any observable educational abilities, and the possibility that educated parents were able to choose the good schools within the locality of residence, invalidating our identification strategy, was forcefully ruled out. Ethiopian parents were simply not sufficiently sophisti-

Ideally, we would want to take children from the same neighborhood and send them to different schools of varying quality in order to isolate the effect of the school. Fortunately, the Ethiopian immigration process did just that in many localities, so when we include locality fixed effects, we exploit variation in school quality within the same locality to explain high school outcomes.³² The cost of including these fixed effects is that we lose a significant amount of degrees of freedom because of the inclusion of 61 new variables, and we effectively lose observations where all the children from the same neighborhood were sent to the same school.

Overall, the results in the fixed-effects specification are not drastically different from those of column (6). While most of the coefficients become less precise, the coefficient on math scores increases to 0.106, and becomes significant at the 10 percent level. On the other hand, the coefficient on the school socioeconomic index is still negative, and becomes puzzlingly nearly three times as large. We suspect that this is due to the strong collinearity between the various measures of school quality, and therefore, in columns (8) and (9) we reestimate the fixed-effects model for the math score and socioeconomic index separately. The coefficient on the math score is virtually unchanged, and is now estimated quite precisely. The magnitude of the coefficient suggests that an Ethiopian child in a given locality who attends a "good" elementary school has a ten percentage points higher probability of passing the matriculation exam relative to her neighbor who attended the inferior school. By contrast, the coefficient on the socioeconomic index in column (9) is insignificant, and substantially smaller in magnitude than that of column (7).

cated or knowledgeable of the Israeli school system to be able to select high quality schools for their children. This is confirmed by running a regression of elementary school quality on parental education (as in Tables II and III) and a full set of locality of residence fixed effects. The *t*-statistics on father's education are 1.19 and 0.32 in the math quality and verbal quality regressions, respectively, and the *t*-statistics on mother's education are 0.11 and -0.27. All the *t*-statistics are well below critical significance levels, indicating that there is no correlation between parental education and school quality *within* localities, as well as between localities.

32. About 50 percent of the variation in school quality is attributable to within locality of residence variation. The 509 Ethiopian students in the sample were distributed among 135 schools and lived in 62 different localities. The nature of these localities varies considerably: they range from temporary caravan sites in rural areas, to medium sized towns (such as Netanya, Ashdod, or Beer-Sheva) and large cities such as Jerusalem. Caravan sites inside the municipal boundaries of a city are classified as part of the city.

V.D. Discussion

Overall, our results indicate that Ethiopian immigrant children who were placed in a better elementary school environment, measured either by math scores or by other environment measures (income per capita, the welfare rate, average high school matriculation rate), tend to perform better in high school, both in terms of progressing through the system without repeating grades, and in terms of achievements on matriculation exams.

Ideally, we would like to identify which aspects of the school environment lead to better high school outcomes for Ethiopian children. Elementary school math scores may reflect the quality of the school: the organization of the educational program, the abilities of teachers, the amount of resources, or the quality of one's peers. However, it is also possible that elementary school math scores are correlated with other aspects of the elementary school environment, and perhaps are picking up the causal effect of these omitted characteristics, rather than the direct effect of school quality. For example, it may be the case that Ethiopian children who live in a wealthier area are more likely to patronize the public library, participate in extracurricular activities, or simply are more motivated to succeed in school to emulate their peers. Alternatively, the prevailing labor market opportunities faced by their parents may also have contributed to the children's scholastic achievements. In these examples, it is not elementary school quality in and of itself (the quality of the educational program, the organizational capabilities of school principals, the abilities of teachers) that affects high school outcomes. Instead, an Ethiopian child placed in a good "environment" (high quality peers, availability of extracurricular activities, good labor market prospects for the parents) would be more likely to succeed, even if she attended a low quality school.

The results in Table VI suggest that it would be inappropriate to attribute all of the effect to elements of the school itself, as the outcome variable is strongly correlated with general features of the school environment, such as the community's income per capita or welfare rate. However, three pieces of evidence hint that what goes on inside the school boundary plays an important role in determining future outcomes. First, if general features of the larger schooling environment are driving the results, we would expect to find similar results using math or verbal scores as our measures of school quality, since both should be correlated in the

same way with other features of the environment (as indicated by Table V for the native Israeli children). This is not the case, and is consistent with the evidence that Ethiopian children studied Hebrew in separate classes. Second, the coefficient on elementary school math scores is largely unaffected by the inclusion of additional measures of the larger schooling environment in Table VI. This contrasts sharply with the results for native Israelis in Table V: the coefficients on math and verbal scores are roughly halved for all of the high school outcomes after including the additional school and community characteristics. Third, the fixed-effects specifications control for all the unobserved characteristics of the locality, and show that variation in school quality within locality of residence (i.e., the larger schooling environment) explains variation in high school success. All of these pieces of evidence suggest that something within the elementary school itself is affecting the high school success of our sample of Ethiopian children. However, these conclusions should remain tentative because we do not have random variation in specific aspects of school quality in order to identify which ones are affecting the children's high school outcomes.

Finally, the analysis of the native Israeli students in Table V raises a few important issues of interpretation. First, the fact that adding additional controls for the schooling environment reduces the coefficients for native Israelis provides additional evidence that they were sorted in a nonrandom fashion across schools. However, the coefficients for the native Israeli sample are somewhat smaller than for the Ethiopian sample, despite the expected bias in favor of finding larger coefficients for the native Israelis.³³ These findings suggest that the effects of school quality may in fact be much larger for the most disadvantaged students than for the other students.

VI. HOW LARGE IS THE EFFECT OF SCHOOL QUALITY?

To illustrate the magnitude of our estimated effects, we predict and compare the outcomes for a student with average characteristics placed in a low or high quality elementary school. Table VII presents these predictions for two important outcomes:

33. It is important to note that the regressions also control for parental education, which explain much more of the variation in high school outcomes for native Israelis than for Ethiopians.

TABLE VII
MAGNITUDE OF THE EFFECTS

	Predicted probability of success for May 1991 Ethiopians in: ^a		Comparison group: Israeli students with: ^b		
	Low math quality school	High math quality school	Father's years of schooling ≤ 8	In the same elementary school as May 1991 Ethiopians	In the same high school as May 1991 Ethiopians
Reached 12th grade without repetition	65.4	74.4	82.3	86.7	92.0
Passing high school matriculation exams	26.4	34.6	40.7	52.7	57.3

a. The predicted probability of success for Ethiopian students is calculated by taking the probit coefficients from Table IV, column (3), and estimating the probability of success for an Ethiopian student with average characteristics in a low quality (bottom three quintiles) and high quality (top two quintiles) school, respectively.

b. Other Israeli students includes all native Jews not of Ethiopian origin, and immigrants from the former Soviet Union who arrived before 1989, and immigrants not of Soviet or Ethiopian origin.

the probability of reaching twelfth grade without repetition and the probability of passing the high school matriculation exams.³⁴

The first two columns in Table VII predict the outcomes for a representative Ethiopian immigrant pupil. The first column predicts the outcome when this representative pupil is placed in a low quality school, and the second column is for when he is placed in a high quality school. The probability of reaching twelfth grade without repetition is increased from 65.4 to 74.4 percent, a 14 percent improvement as a result of moving from a low to a high quality school. The probability of passing the high school matriculation exams is increased from 26.4 to 34.6 percent, a 31 percent improvement as a result of moving from a low to a high quality school. These are large effects, even dramatic in the case of affecting the probability of obtaining a matriculation diploma.

We can also gauge the relative size of the "school quality" effect by assessing how much of the gap in high school outcomes between Ethiopian and native children can be closed by simply

34. The prediction is based on the coefficient for the high average math percentile dummy in the benchmark model (column (3) of Table IV).

moving an Ethiopian child from a low to high quality school. We perform these calculations for three native comparison groups: (a) "Other Israeli" students (i.e., Jewish students excluding Ethiopian and former Soviet Union immigrants) whose fathers had less than eight years of schooling; (b) Other Israeli students who were in the same elementary school as the May 1991 Ethiopians; and (c) Other Israeli students who were in the same high school as the May 1991 Ethiopians. The mean outcomes used for these three comparison groups are displayed in columns (3)–(5) of Table VII.

The gap in the probability of reaching twelfth grade without repetition between Ethiopians with average characteristics in low quality elementary schools and each of the three comparison groups is 16.9, 21.3, and 26.6 percentage points, respectively. If all Ethiopians were to be placed into high quality elementary schools, the gaps relative to the three comparison groups are reduced dramatically to 7.9, 12.3, and 17.6 points, respectively. Most dramatic is the declining gap relative to the group of Israeli pupils closest to the Ethiopians in terms of family educational background.

The gap in the probability of passing the high school matriculation exams between Ethiopians with average characteristics in low quality schools and each of three comparison groups is 14.3, 26.3, and 30.9 percentage points, respectively. If all Ethiopians were placed in high quality elementary schools, these gaps would be reduced significantly to 6.1, 18.1, and 22.7 percentage points, respectively. Again, most dramatic is the closing of more than a half of the gap relative to the group of Israeli pupils who had a similar family background in education.

VII. CONCLUSION

The analysis in this paper exploits the exogenous variation in school quality created by the random assortment of Ethiopian immigrant children into schools upon their arrival after Operation Solomon. This natural experiment created a unique research opportunity to study the effects of the elementary schooling environment on high school outcomes.

The results suggest that elementary schools that are strong in math have a significant impact on a student's chances of dropping out of high school and on the probability of passing the matriculation exams, which are necessary to enter college. These

results are not sensitive to the inclusion of additional controls for the schooling environment or the inclusion of community fixed effects. Furthermore, these findings are robust to using alternative measures of the schooling environment instead of the average math scores of the elementary school. At the minimum, these results point to the importance of the early schooling environment in determining high school achievements, in contrast to the ambiguous findings about the effect of neighborhoods on labor market outcomes [Katz, Kling, and Liebman 2001; Oreopoulos 2003; Jacob forthcoming]. A possible reconciliation of these findings is that school quality is more important than neighborhood quality in determining outcomes.

We believe that these results can have important implications that go beyond the immediate but narrow Israeli context. First, this paper is one of the first attempts at estimating precisely the effect of school quality in a setting that resembles as closely as possible the ideal conditions of a controlled laboratory experiment. Second, all industrialized countries have seen a sharp increase in immigration rates from the developing world in the past two decades. The question of how to successfully integrate younger generations of immigrants, first in the school system, and subsequently in the fabric of society, is of concern to policy-makers throughout the Western world.

Third, substantial gaps in educational achievements exist in many countries among natives of different ethnic or racial background. The gap in educational achievements between blacks and whites in the United States is quite similar to the gap between Ethiopians and native Israelis. The results in this paper suggest that a substantial fraction of the gap could be closed if minority students attended higher quality elementary schools. Finally, our results can also be placed in the context of the developing world, and Africa in particular. Sixty-five percent of the children in our cohort reached twelfth grade, a remarkable improvement relative to the educational achievements of their parents. The mean high school outcomes of the new Ethiopians in Israel, especially of those who were placed in good elementary schools, should strengthen the drive for improving school quality in poor countries in their quest for economic and social development.

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