

KIBBUTZ EDUCATION: IMPLICATIONS FOR NURTURING CHILDREN FROM LOW-INCOME FAMILIES

YAAKOV GILBOA*

A natural experiment in education on Israeli kibbutzim, where investment in human capital is equal for all children, allows us to differentiate between the effect on children's grades of genetics and home environment on the one hand and of material resources invested in education on the other hand. In addition, comparing the educational achievements we find no difference among children whose parents have more than 12 years of schooling. However, the average grade of children whose parents have 12 years of schooling or less in kibbutzim is 0.25 of a standard deviation higher than in cities. This difference can be attributed to the higher investment in human capital in kibbutzim, implying that more public resources should be allocated to the education of children from low-income families.

1. INTRODUCTION

Children's achievements in school and later as adults in the workplace are highly correlated with their parents' characteristics and income, as well as with the environment in which they were raised. However, how these three factors determine achievements—how they contribute to human capital—is ambiguous. Parents' genes, culture and wealth, which are highly correlated with each other, are transmitted to their children and together determine their future success. Separating their individual contributions to the accumulation of human capital is essential for designing effective policies aimed at enhancing the achievements of children from low-income families.

Here we use a natural experiment in education on Israeli kibbutzim, where investment in human capital of a child is independent of parents' income and family size, to separate the contribution of genetic factors and the home environment from the direct investment of material resources in education to children's grades. Many studies show that the educational achievements of children of highly educated and wealthy parents are higher than those of children of less educated and less wealthy parents.¹ This can be attributed to two factors that act through two different channels:

- a. On average, highly educated and wealthy parents automatically and without cost pass on to their children higher abilities and stronger motivation to learn than less educated and less wealthy parents.
- b. Such parents invest more resources in their offspring's human capital.

* Ben Gurion University.

¹ Bowles and Nelson (1974); Behrman and Taubman (1989); Blackburn and Neumark (1993); Currie and Thomas (1999a and 1999b); Ermisch and Francesconi (2001).

Increasing public investment in the education of children from low-income families operates only through the second channel: increasing the available resources for the education of these children. Therefore, it is important to assess the contributions of each channel to educational achievement in order to understand what can be achieved by increasing this investment.

Previous studies have generally used data on twins, relatives and adopted children to learn about the contribution of genetics, family background and investment in education to education's outcomes (Ashenfelter and Rouse (1998), Behrman, Rosenzweig and Taubman (1994), Behrman and Taubman (1989), Scarr and Yee (1980)). In this research we take a different approach. First we estimate the effect of genetic and cultural transmission from parents to child using data on educational outcome of children in kibbutzim where the outdoor environment is the same for everyone and investment in education is equal for all the children. Therefore, any differences in education outcomes between children can be attributed to differences in innate abilities and home environment.² Then we compare the educational outcomes of kibbutz children to those of city children and estimate the effect of direct material investment on educational achievements.

Dar (1994) compared the educational achievements of eighth and ninth grade children from cities with those from kibbutzim and found that the average score of the kibbutz educated children was 0.34–0.38 standard deviations higher than the average score of children from the cities, and that their variance was lower. The correlation coefficient between test scores and the socioeconomic status³ of the family was lower in the kibbutzim as was the correlation between test scores and parents' ethnic origin. Dar (1994) attributes the gap in scores to differences in educational attitudes of schools. Dar (1994) also found that this gap is much smaller (0.10–0.13 s.d) when the comparison is limited to children of high socioeconomic status, implying that differences in economic resources may explain at least part of the gap in scores.

Our findings show that parents' investment in their children's education contributes significantly to the educational achievements of their offspring. The average score of city children whose parents have more than 12 years of schooling is equal to the average score of kibbutz children whose parents have the same level of education. The average score of children in the kibbutz whose parents have 12 years of schooling or less is one third of a standard deviation higher than the average score of children in the cities whose parents have 12 years of schooling or less. We attribute this difference to the fact that kibbutzim invest more in their children's education.⁴

The rest of the paper is organized as follows. In section 2 we provide a brief description of the kibbutz and its education system. In section 3 we present a formal model of investment in children's education. We show that holding all other family and parents' characteristics constant (i.e., income, number of children in the family, etc.) the kibbutz spends more money to educate each child than families in cities. Section 4 presents data on educational achievements and

² This is the relevant distinction for assessing the effect of public investments in the education of children from low-income families on their achievements.

³ Socioeconomic status was determined by parents' education and father's occupation.

⁴ Shmueli (1989) found that a family in the kibbutz spends more than a family in the upper decile of the income distribution in the city to educate their children. Data from the education department of the Kibbutz Movement shows that the kibbutz invests about \$500 more per year in the high school education of each child than a family in the city. More evidence on the high investment of kibbutzim in their children's human capital is available on request from the author.

family characteristics of children in the cities and in the kibbutzim. Section 5 presents the estimation results and the last section draws conclusions.

2. THE KIBBUTZ

About 1.8 percent of Israel's population lives in about 250 kibbutzim. The kibbutz is a small, rural community, based on a socialist ideology: all the property belongs to the kibbutz and the kibbutz provides all its members' needs (food, housing, health, education, etc.) on an equal basis. Every kibbutz member works either in the kibbutz enterprises (in industry, agriculture, tourism and community services) or outside the kibbutz. All income goes to the kibbutz. Major decisions are made by majority vote of all the members. Committees, appointed by the members, make more minor decisions. An important committee in kibbutz life is the committee for education. This committee makes all the decisions related to children's education.

Since our main interest is educational achievement, a brief description of how children are raised in the kibbutz is worthwhile. After birth, a child spends several months at home with the mother. When she returns to work, children are kept first in a nursery and then in a kindergarten during work hours under the supervision of professional kindergarten teachers. Kibbutz children begin school at age six. Both elementary and high schools are regional schools where children from nearby kibbutzim learn together. The kibbutz education system is part of the national education system so the curriculum in these schools is the same as in all other schools in Israel. Schools are nationally funded but kibbutzim, like other local authorities, can supplement national funding from their own resources. At the end of twelfth grade, students may take a nationwide matriculation exam and psychometric test which are required for admission to most university courses.

After compulsory military service, young adults generally return to the kibbutz and are usually permitted to delay their decision on kibbutz membership for several years. During these years, those who wish to continue their education do so. At the end of this postponement they decide whether to become members of the kibbutz or not. The trend nowadays is to leave the kibbutz (see Figure 1).

For this research, it is important to keep in mind two major facts:

- In the kibbutz, parents cannot leave individual bequests to their offspring, and as most children leave the kibbutz when they become adults, parents cannot leave them collective assets either.
- Investment in children's education in the kibbutz is a collective decision and investment in every child is the same.

These two facts account for the high investment in human capital of children in kibbutzim, as we show in the next section.

3. THE MODEL

We present a simple model of parent's investment in their children's human capital in cities and in kibbutzim in order to explain the differences in the distribution of educational achievements between children from cities and from kibbutzim. Estimation of the parameters of the model then shows that public investment in education of children from low-income families can improve their educational achievements.

a. City families⁵

Assume that human capital of a child j from family i , denoted by h_{ij} , is an increasing function of traits she gets from her parents and educational goods she consumed during her childhood. Traits which are transferred from parent to child without any cost include inherited abilities, culture, motivation, and so on. Denote by a_{mi} traits that pass from the mother to the child, and by a_{fi} traits that pass from the father to the child. Denote by I_i the value of educational goods such as books, computers, private lessons, and the time parents invest to develop their child's human capital. We assume that when child j from family i reaches adulthood and leaves her parents' home, her human capital is:

$$(1) \quad h_{ij} = \mu a_{mi}^\gamma a_{fi}^\delta I_{ij}^\eta.$$

Parents get utility from family consumption (C_i), their children's human capital, and gifts and bequests which they give to their children. We assume that parents' utility function is:

$$(2) \quad U_i = \ln(C_i) + \sum_{j=1}^{n_i} \ln(h_{ij}) + \theta \sum_{j=1}^{n_i} \ln(b_{ij}),$$

where n_i is the number of children in family i , b_{ij} is the bequest the parents give to the j^{th} child, and θ is a common, positive parameter that determines the relative weight of bequests. A value of θ less than one means that parents weigh the child's own earnings more highly than money the child receives as a bequest.⁶

Parents buy some of the educational goods their children use and finance it from their own wealth. Other educational goods are supplied in equal measure to all children by the national education system. Denoting by I_{ij} parents' expenditure on their child's education, and by I_g , public expenditure on education per child, and assuming that the number of children is exogenous and parents treat all their children equally, parents maximize their utility:

$$(3) \quad \text{Max } U_i = \ln(C_i) + n_i \ln(\mu) + \gamma n_i \ln(a_{mi}) + \delta n_i \ln(a_{fi}) + \eta n_i \ln(I_i + I_g) + \theta n_i \ln(b_i)$$

subject to their budget constraint:

$$C_i + n_i I_i + n_i b_i = y_i,$$

where $I_i, b_i \geq 0$, and y_i is parents' lifetime income. From the first order conditions we obtain that the optimal investment in each child's education is:

$$(4) \quad I_i = \begin{cases} 0 & \text{if } y_i \leq \bar{y}_i \\ \frac{\eta y_i - (1 + \theta n_i) I_g}{1 + n_i(\theta + \eta)} & \text{if } y_i > \bar{y}_i \end{cases}$$

where \bar{y}_i is a threshold income for private investment in education, and

⁵ This follows Becker and Tomes (1986).

⁶ Not all the benefits of human capital are pecuniary benefits. Thus, human capital gets a higher weight in the utility function relative to bequests (Taubman 1989).

$$(5) \quad \bar{y}_i = \frac{(1 + \theta n_i) I_g}{\eta}.$$

Total investment in education of each child j from family i is:

$$(6) \quad \hat{I}_i = I_i + I_g = \begin{cases} I_g & \text{if } y_i \leq \bar{y}_i \\ \frac{\eta(y_i + n_i I_g)}{1 + n_i(\eta + \theta)} & \text{if } y_i > \bar{y}_i \end{cases}$$

Therefore, the human capital of each such child is:

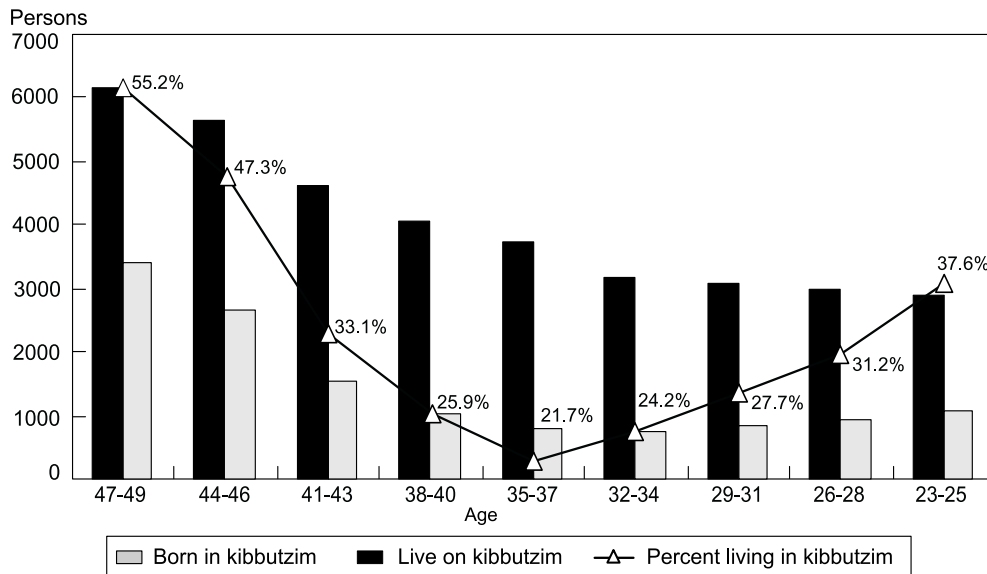
$$(7) \quad h_{ij} = \begin{cases} \mu a_{mi}^\gamma a_{fi}^\delta I_g^\eta & \text{if } y_i \leq \bar{y}_i \\ \mu a_{mi}^\gamma a_{fi}^\delta \left[\frac{\eta(y_i + n_i I_g)}{1 + n_i(\eta + \theta)} \right]^\eta & \text{if } y_i > \bar{y}_i \end{cases}$$

From (6) we get that the marginal addition to total investment in education from increasing public investment is:

$$(8) \quad \frac{\partial \hat{I}_i}{\partial I_g} = \begin{cases} 1 & \text{if } y_i \leq \bar{y}_i \\ \frac{\eta n_i}{1 + n_i(\theta + \eta)} < 1 & \text{if } y_i > \bar{y}_i \end{cases}$$

This means that rich parents who invest in education from their own resources reduce their investment when public investment is increased. Children from poor families benefit from all the additional investment.

Figure 1
Adults Born and Living in Kibbutzim During 2001



b. Kibbutz families

Assume that z families live in a kibbutz. The total income of the kibbutz is Y and the total number of children in the kibbutz is N . Parents have the same preferences as parents in cities but they cannot leave individual bequests to their children, and as most children leave the kibbutz upon adulthood, parents also cannot leave more collective assets for their children.

Also assume that resources are divided equally and kibbutz decisions are made so as to maximize the sum of the utilities of its members. Denoting by I_k investment in each child's education, the kibbutz maximizes the sum of the utilities of its members:

$$(9) \quad \underset{C_i, I_k}{\text{Max}} \quad U = z \ln(C_i) + N \ln(\mu) + \sum_N [\gamma \ln(a_{mi}) + \delta \ln(a_{fi}) + \eta \ln(I_k + I_g)]$$

subject to the budget constraint:

$$zC_i + NI_k = Y,$$

where $I_k \geq 0$.

The chosen value of investment in the education of a kibbutz child is then:

$$(10) \quad I_k = \begin{cases} 0 & \text{if } \bar{y} \leq \bar{y}_k \\ \frac{\eta Y - zI_g}{z + \eta N} = \frac{\eta \bar{y} - I_g}{1 + \eta \bar{n}} & \text{if } \bar{y} > \bar{y}_k \end{cases}$$

where \bar{y} is the average income of a family and \bar{n} is the average number of children in a family. The threshold level of average income per family in the kibbutz for investment in education is $\bar{y}_k = I_g / \eta$. In the city, this threshold depends on the number of children in the family. In the kibbutz it depends on the total number of children in the kibbutz. Total investment in each child in the kibbutz is:

$$(11) \quad \hat{I}_k = I_k + I_g = \begin{cases} I_g & \text{if } \bar{y} \leq \bar{y}_k \\ \frac{\eta \bar{y} + \bar{n} I_g}{1 + \eta \bar{n}} & \text{if } \bar{y} > \bar{y}_k, \end{cases}$$

and the human capital of child j is:

$$(12) \quad h_{ij} = \begin{cases} \mu a_{mi}^\gamma a_{fi}^\delta I_g^\eta & \text{if } \bar{y} \leq \bar{y}_k \\ \mu a_{mi}^\gamma a_{fi}^\delta \left[\frac{\eta(\bar{y} + \bar{n} I_g)}{1 + \eta \bar{n}} \right]^\eta & \text{if } \bar{y} > \bar{y}_k. \end{cases}$$

Educational achievement like test scores are indicators of the child's human capital and we assume the following relation between human capital and test scores:

$$(13) \quad t_{ij} = \ln(h_{ij}) = \ln(\mu) + \gamma \ln(a_{mi}) + \delta \ln(a_{fi}) + \eta \ln(\hat{I}_k) + u_{ij},$$

where u is an i. i. d. disturbance term, normally distributed with zero mean and variance σ^2 .

Suppose that the income of a family in the city equals the average income of a family in the kibbutz, its number of children equals the average number of children per family in the kibbutz and the parents have the same abilities. If the kibbutz invests in its children's education, the expected grades of a child will be higher than the expected grades of a child who was educated in the city. To see this we return to equations (5) and (10). Because kibbutz parents cannot

leave bequests to their children, the kibbutz invests more in each child than the city family and therefore the child from the kibbutz has more human capital.

Furthermore, if their income satisfies $\frac{I_g}{\eta} < \bar{y} < \frac{(1 + \theta\bar{n})I_g}{\eta}$, the kibbutz will invest in

education but the family in the city will not.

Estimating the parameters of equation (13) directly is impossible because genetic and cultural transfers are not observable and data on parents' investment in educating their children is inaccessible. The first problem is usually solved by using parents' education and other family characteristics as proxies for these transfers. The second is solved by using family income, number of siblings, etc. as proxies for this investment. Since the goal of this research is to identify the marginal contribution of public investment in education of children from poor families, and since the model predicts that in these families parents do not invest in education, estimating equation (13) with these proxies from data on children who were educated in cities will not solve our identification problem because of the highly positive correlation between parents' education, parents' income and parents' investments in their children. Data on children who were educated in kibbutzim, where investment in human capital is independent of parents' education, allow us to separate these factors. Therefore, we estimate the model twice: first we use data on children who were educated on the kibbutz and then data on children educated in the city. The differences in the parameters of parents' education between the city estimate and the kibbutz estimate are the marginal effect of investment in education on grades.

4. THE DATA

We estimate the model using data from psychometric test results of the National Institute for Testing and Evaluation in Israel for the years 1992-1996.⁷ The data contains information on grades as well as other individual and family characteristics of examinees who were Jewish, native born, and 31 years old or younger. Table 1 provides descriptive statistics on the two samples: examinees who were educated in kibbutzim and those educated in cities. As can be seen, the average score of kibbutz examinees is 0.25 of a standard deviation higher than the average score of city examinees and the standard deviation of kibbutz examinees is about 8 percent smaller. The average years of parents' schooling (mothers and fathers) is also higher in the kibbutzim. Table 2 presents the simple correlation coefficients between the variables for the two samples. The correlation between the scores and years of schooling of mothers is about twice as high in cities as in kibbutzim, and the correlation between the scores and years of schooling of fathers is about 1.5 times higher in cities than in kibbutzim. These findings reflect differences in investment in education arising from differences in family income of families living in cities. While in kibbutzim the investment in each child is the same, in cities, due to the higher correlation between family income and parents' years of schooling, parents with more education can invest more in their children's human capital and therefore the correlation between children's scores and parents' education is higher.

Our comparison of scores could be biased if the motivation for taking the psychometric test is different in the kibbutz and in the city. However, Avrahami's (1997) study of the reasons

⁷ Universities in Israel use this test for screening applicants. The test is similar to the SAT test given in the US. For more details on this test see Beller (1994).

Table 1
Descriptive statistics of the data

		Total score	Verbal	Math	English	Mother's education (years)	Father's education (years)
Average	city	552.69	108.35	109.87	109.44	13.04	13.21
	kibbutz	578.77	116.88	110.61	113.90	13.87	13.94
Median	city	553	109.00	110.00	110.00	12	12
	kibbutz	582	118.00	111.00	116.00	14	14
Standard deviation	city	97.02	18.59	18.79	22.06	3.11	3.36
	kibbutz	90.15	17.22	18.32	20.75	2.51	2.67
N	city	8,779					
	kibbutz	4,726					

N – number of observations.

Table 2
Coefficients of correlation (cities are above the diagonal and kibbutzim are under the diagonal)

	Total score	Verbal	Math	English	Mother's education	Father's education
Total score	1	0.914	0.890	0.824	0.365	0.355
Verbal	0.905	1	0.682	0.699	0.324	0.298
Math	0.876	0.651	1	0.599	0.296	0.296
English	0.780	0.656	0.509	1	0.366	0.370
Mother's education	0.187	0.171	0.157	0.155	1	0.646
Father's education	0.209	0.183	0.172	0.191	0.423	1

for kibbutz-educated young adults continuing their education after high school found that independent of future plans to stay in the kibbutz or leave it, the main reason was their recognition of the importance of education for future success. This suggests that there is little differences between city and kibbutz educated young adults in their decision to take the test.

5. RESULTS

Applying equation (13), we estimate the following equation separately for the two samples.

$$(14) \quad t_i = b_{j0} + b_{jm} S_{mi} + b_{jf} S_{fi} + b_j x_i + u_{ji}, \quad j = k, l,$$

where k denotes kibbutz and l denote city. S_m is mother's years of schooling, S_f is father's years of schooling, x is a vector of personal and family variables such as age when the test was taken, gender, and parents' ethnic origin. Note that for the city examinees, S_m and S_f are proxies for parents' ability and income. In the kibbutzim it is a proxy only for ability.⁸

⁸ Rosen (1977) shows that more able individuals choose more schooling and earn more than less able individuals. Hence, years of schooling has a positive correlation with abilities as well as with earnings.

We expect that $b_{k0} - b_{i0} > 0$ because kibbutz members cannot leave bequests to their children. Further we expect $b_{kf} - b_{kf}$ and $b_{km} - b_{km}$ to be positive since they reflect ability and income in the cities and ability alone in the kibbutzim. Table 3 presents the estimates of equation (14) separately for kibbutz and city examinees. As the model predicts, the constant in the kibbutz regression is 1.54 times the constant in the city regression. The coefficients of father’s education

Table 3
OLS regression, dependent variable – Total score

	City		Kibbutz	
	Coeff.	Std.err	Coeff.	Std.err
C	270.84	43.563	416.75	69.734
Age	15.93	4.089	12.44	6.108
Age ²	-0.43	0.096	-0.41	0.134
Female	-47.40	2.012	-55.18	2.837
Father’s education	5.30	0.379	4.74	0.540
Mother’s education	7.12	0.414	3.91	0.573
R ²	0.220		0.141	
N	7,753		4,145	

and mother’s education in the city regression are 1.12 and 1.82 times the coefficients in the kibbutz regression, respectively. In contrast to the literature,⁹ the coefficient of father’s education in the kibbutz is higher—though not significantly so—than the coefficient of mother’s education. In the cities, the coefficient of mother’s education is significantly higher than the father’s.¹⁰

The Chow test confirms that the two regressions are different. We estimate the following equation from the joint sample (N = 11,584) to discover which of the coefficients is different in the two regressions:

$$(15) \quad t_i = b_0 + b_m S_{mi} + b_f S_{fi} + b x_i + Db_1 + Db_2 S_{mi} + Db_3 S_{fi} + Db_4 x_i + u_i ,$$

where D is a dummy variable, D = 0 for the kibbutz examinees and D = 1 for the city examinees. The coefficients in this regression are the differences in coefficients in the former regressions. The results of this estimate are presented in Table 4. As can be seen, the constant, the gender coefficient, and the mother’s education coefficients are statistically

Table 4
Estimating the differences in coefficients between city and kibbutz children

	Coeff.	Std.err
C	-145.92	82.921
Age	3.49	7.408
Age ²	-0.02	0.166
Female	7.78	3.503
Father’s education	0.56	0.665
Mother’s education	3.21	0.712
R ²	0.208	
N	11,898	

⁹ See for example Datcher-Loury (1988), Ermisch and Francesconi (2001), and Scaerdote (2000).

¹⁰ The hypothesis of equality of the coefficient is not rejected for the kibbutzim, F-statistic = 0.794. However, the hypothesis is rejected for the cities, F-statistic = 6.535, a = 0.05.

different.¹¹ These preliminary results confirm our hypothesis that greater investment of material resources in education improves educational achievements.

In the following regressions we add an interaction term between parents' education and parent's ethnic origin as regressors. We estimate the equation:

$$(16) \quad t_i = b_{j0} + b_{jm} S_{mi} + b_{jf} S_{fi} + f_{jm} S_{mi}^2 + f_{jf} S_{fi}^2 + f_{jmf} S_{mi} S_{fi} + b_j x_i + u_{ji} .$$

Table 5 shows the results of the regressions. The constant of the regression is 61 percent higher in the kibbutz than in the city. The marginal contribution of an additional year of father's schooling (calculated at the average point of parents' schooling) is 5.15 points for city examinees and 4.28 points for kibbutz examinees. The marginal contribution of an additional

Table 5
OLS regression, dependent variable – Total score

	City		Kibbutz	
	Coeff.	Std.err	Coeff.	Std.err
C	302.01	45.249	487.42	72.875
Age	20.14	4.186	10.88	6.121
Age ²	-0.53	0.098	-0.37	0.134
Female	-46.42	2.034	-53.88	2.829
F's ed	-0.675	1.600	4.39	2.964
M's ed	2.730	1.565	-2.59	2.670
Father's education ²	0.322	0.076	0.19	0.114
Mother's education ²	0.258	0.080	0.42	0.105
Father's and mother's education	-0.206	0.132	-0.39	0.181
Father b1	-9.94	2.970	-19.23	5.102
Father b2	-6.61	4.406	-10.63	5.439
Father b3	-7.92	3.232	-16.86	4.856
Father b4	3.91	10.755	-8.47	10.318
Father b5	5.08	9.000	-17.35	6.816
Father b6	-27.71	17.266	-11.67	16.614
Father b7	-27.24	6.746	-34.98	11.063
Mother b1	-5.52	3.088	-17.02	5.685
Mother b2	-5.40	4.436	-1.34	5.559
Mother b3	-6.87	3.383	-0.06	5.638
Mother b4	1.82	10.076	8.63	7.359
Mother b5	2.31	9.099	-1.59	6.783
Mother b6	1.99	17.255	4.16	15.215
Mother b7	-18.25	7.064	-32.00	11.829
R ²	0.2294		0.1550	
N	7498		4086	

Parent's ethnic origin: the base group is native born. b1 – North Africa (including Ethiopia) or Asia. b2 – Western Europe. b3 – Eastern Europe. b4 – United States or Canada. b5 – Latin America. b6 – South Africa or Australia. b7 – elsewhere.

¹¹ The constants are significantly different at the 10 percent level, the other two coefficients are significantly different at the 5 percent level.

year of mother's schooling (also calculated at the average point of parents' schooling) is 6.73 points for city examinees and only 3.62 points for kibbutz examinees. These differences are the result of the correlation between parents' schooling (income) and investment in children's human capital. The Chow test confirms that the two regressions are again different.¹² In general, our estimates suggest that differences in genes and home environment, as reflected in parents' education, account for only a small fraction of the variance in scores.¹³ Differences in outdoor environment and investment in education, as reflected in years of parents' education in the cities, explain another 7.5 percent of the variance.¹⁴

A surprising result was the effect of parents' ethnic origin on children's scores in kibbutzim. In a small rural community, where investment in each child is the same one may expect that effect of differences in parents ethnic origin (i.e. differences in parents culture) will disappear by the age of 17 years, the age of the youngest examinee in our sample. The expected score of a child who was born to parents from North Africa, Asia or Ethiopia is 36 points lower than the expected score of a child whose parents are native born (19.23 points if the father was born in North Africa or Asia, 17.02 points if the mother was born there). For a city-educated child the score decreased by only 15 points (9.94 points if the father was born in North Africa Asia or Ethiopia, 5.52 points if the mother was born there). If the father was born in Eastern Europe, the expected score of the child is 17 points lower than of the child of a native-born father in the kibbutz and only 8 points lower in the city.¹⁵ As in other studies, the average score of a female examinee is about half a standard deviation lower than the average score of a male examinee (see, for example, Bridgman, and McCamley and Ervin (2000) and Young (2001) for gender differences in SAT scores in the USA).¹⁶

The results from the kibbutz regression indicate the importance of genetics and home environment to education outcomes. Even though the external environment is held constant and investment in education is equal, parents' characteristics still influence their children. The magnitude of the influence of parents' ethnic origin in the kibbutzim is unexpectedly higher than in the cities, possibly because of the high correlation between parents' ethnic origin and parents' schooling in cities.

The theoretical framework presented in section 3 implies that in cities, the higher parents' level of schooling, the larger the correlation between test scores and parents' schooling. The reason is that educated parents earn more and hence can invest more in their children's human capital. Public investment in the education of children from low-income families, where parents do not invest at all or invest very little in their children's human capital, weakens the correlation between test scores and parents' schooling.¹⁷ Therefore, we estimate equation (16) separately for two sub-samples: one in which both parents' education exceeds 12 years, and another in which parents' education is 12 years or less.

¹² The F-statistic equals 7.25 while the critical value is 1.52.

¹³ $R^2 = 0.155$ in the kibbutzim while age, age² and female explain 9.6 percent of the variance.

¹⁴ $R^2 = 0.229$ in the cities. Age age² and female explain 8.8 percent of the variance.

¹⁵ Dahan et al. (2002) found that after controlling for family wealth, there is no difference in the probability of a child achieving a matriculation certificate at the end of twelfth grade independent of parental origin.

¹⁶ However, Dahan et al. (2002) found that the probability of a female examinee achieving a matriculation certificate is higher than the probability of a male examinee doing so.

¹⁷ Becker and Tomes (1986) said that the Income correlation between parents and children will be lower in rich families. Public investment in education of children from low-income families can reverse this relation.

Table 6
Descriptive statistics of two sub-samples

a. Both parents with more than 12 years of education

	City	Kibbutz
Average score	597.09	594.93
Females (percentage in the sample)	52.41	55.71
Correlation between scores and mother's schooling	0.213	0.089
Correlation between scores and father's schooling	0.178	0.122
Father is native born (percentage in the sample)	56.46	70.85
Mother is native born (percentage in the sample)	60.58	78.48
Father North Africa or Asia (percentage in the sample)	11.69	5.58
Mother North Africa or Asia (percentage in the sample)	9.21	2.99

b. Parents' education 12 years or less

	City	Kibbutz
Average score	515.13	545.31
Females (percentage in the sample)	56.74	52.29
Correlation between scores and mother's schooling	0.160	0.052
Correlation between scores and father's schooling	0.120	0.088
Father is native born (percentage in the sample)	40.48	58.03
Mother is native born (percentage in the sample)	47.69	59.58
Father North Africa or Asia (percentage in the sample)	36.68	14.79
Mother North Africa or Asia (percentage in the sample)	31.18	14.68

Table 6 presents descriptive statistics for these two sub-samples. The average scores in the two sub-samples are the same when parents' schooling is more than 12 years, and 30 points higher in kibbutzim when parents' schooling is 12 years or less. These results must be interpreted with caution because of the differences in the distribution of females and parents' ethnic origin between kibbutzim and city examinees (more females in the kibbutzim in the first group, more females in the cities in the second group, more parents who came from North Africa, Asia or Ethiopia in the cities in both groups). After calculating the average again, taking into account these differences,¹⁸ in the upper level of parents' education, the average scores of the two groups are equal. In the lower level (parents' schooling reaching high school or less) the average score in the kibbutzim is 23 points (about 0.25 standard deviation) higher than the average score in the cities.

Table 7 presents the results of the estimations of equation (15) for the children of parents with more than twelve years of schooling. In the kibbutzim, parents' education is not significant,

¹⁸ Since the average score of a female examinee in the city is 47 points lower than that of male examinee, more females in the city sample lower the average score as happen when more parents are not native born. Therefore, we equate the share of female examinees and parental origin in the cities to those in the kibbutzim.

Table 7
OLS regression, dependent variable – Total score. Parents' education – more than high school

	City		Kibbutz	
	Coeff.	Std.err	Coeff.	Std.err
C	84.78	223.715	631.74	267.726
Age	-0.23	9.909	11.06	9.128
Age ²	-0.06	0.242	-0.38	0.204
Female	-37.40	3.326	-50.59	4.086
Father's ed	51.64	19.403	11.65	22.151
Mother's ed	6.34	18.798	-25.74	23.226
Father's ed ²	-0.95	0.596	-0.05	0.669
Mother's ed ²	0.53	0.584	1.02	0.703
Father's and mother's education	-0.98	0.470	-0.34	0.608
Father b1	-25.97	5.750	-17.59	8.218
Father b2	-12.57	6.565	-18.48	8.127
Father b3	-12.08	4.828	-13.68	7.710
Father b4	-4.13	11.809	-8.62	13.649
Father b5	-13.01	11.731	-11.89	9.805
Father b6	-11.65	22.624	-56.29	24.920
Father b7	-47.67	14.004	-59.11	19.681
Mother b1	-10.69	6.312	-17.50	10.962
Mother b2	-7.17	6.591	-0.19	8.323
Mother b3	-9.70	4.940	10.19	9.062
Mother b4	0.87	11.167	18.67	9.457
Mother b5	-1.89	12.037	-4.98	10.166
Mother b6	13.36	28.075	16.86	25.870
Mother b7	-16.72	14.479	-6.16	19.700
R ²	0.1267		0.1127	
N	2694		2007	

Parents' ethnic origin: the base group is native born. b1 – North Africa (including Ethiopia) or Asia. b2 – Western Europe. b3 – Eastern Europe. b4 – United States or Canada. b5 – Latin America. b6 – South Africa or Australia. b7 – elsewhere.

while in the cities father's education and the interaction between father's and mother's education are significant. In the kibbutzim the coefficients of North Africa, Asia or Ethiopia origin are only slightly different from those in Table 5. However, in the cities the coefficients change dramatically and are now significantly negative, implying that for the children of more educated parents the average score of a child whose parents were born in North Africa is one third of a standard deviation lower than the average score of a child whose parents were native born. The disadvantage of Eastern European origins is also greater for urban children with more educated parents than for urban children in general.

Table 8 presents the results of the estimations of equation (15) for the children of parents with 12 years of schooling or less. Parental education coefficients are not statistically significant for kibbutz children whose parents have 12 years of schooling or less. For city children, only

Table 8
OLS regression, dependent variable – Total score. Parents' education – high school or less

	City		Kibbutz	
	Coeff.	Std.err	Coeff.	Std.err
C	156.11	64.370	449.24	152.576
Age	33.84	5.741	15.76	12.918
Age ²	-0.83	0.130	-0.45	0.276
Female	-54.46	3.182	-57.31	6.189
Father's ed	-1.44	2.746	7.24	9.836
Mother's ed	5.31	2.713	-4.64	9.078
Father's ed ²	0.09	0.197	-0.22	0.814
Mother's ed ²	-0.21	0.191	0.07	0.398
Father's and mother's education	0.23	0.274	0.04	0.826
Father b1	-0.61	4.255	-19.94	9.124
Father b2	-1.92	7.524	16.60	11.741
Father b3	3.19	5.778	-7.81	9.671
Father b4	-120.54	98.124	-7.41	38.929
Father b5	-0.16	21.831	-15.08	16.239
Father b6	-59.49	28.581	48.65	42.359
Father b7	-14.99	8.906	-6.09	19.171
Mother b1	-2.86	4.258	-18.63	9.428
Mother b2	-4.29	7.943	-6.38	12.520
Mother b3	-8.21	6.205	-17.43	11.087
Mother b4	87.31	49.339	0.69	23.666
Mother b5	39.60	18.286	-6.53	15.276
Mother b6	38.89	27.690	-20.80	30.129
Mother b7	-15.08	9.119	-37.33	19.093
R ²	0.1308		0.1322	
N	3095		872	

Parents' ethnic origin: the base group is native born. b1 – North Africa (including Ethiopia) or Asia. b2 – western Europe. b3 – Eastern Europe. b4 – United States or Canada. b5 – Latin America. b6 – South Africa or Australia. b7 – elsewhere.

the coefficient of mother's schooling is significant. The North Africa, Asia or Ethiopia origin coefficients are not significant in the cities, while in the kibbutzim these coefficients are significant and similar in magnitude to those shown in Table 5.

6. POLICY IMPLICATIONS AND CONCLUSIONS

In this paper we used a natural experiment in education on kibbutzim in Israel to distinguish between the effect on educational outcomes of genetic transmission and home environment on the one hand and of the contribution of money invested in education on the other. The results indicate two important conclusions for public policy. One is that public investment in education has a long-term effect on educational achievements of children from low-income

families. The higher average score of children whose parents have 12 years of schooling or less in the kibbutzim is due to higher investment in education in those children. This investment is made by the kibbutz and not by each family independent of family size, parents' earnings, etc. Therefore this investment is similar to public investment. Thus, increasing public investment in education of similar children in the cities will improve their education outcomes.

The second conclusion is that public investment in education of children from low-income families cannot completely compensate for early deprivation of a nurturing home environment. The regressions in Tables 7 and 8 show that parents' ethnic origin (a proxy for their culture) is more influential when investment in education is high. In kibbutzim, where investment in education is equal for all children and relatively high, parents' ethnic origin is significant independent of parents' education while in the cities parents' ethnic origin is significant only when parents are well educated and therefore can afford to invest in the education of their children. Thus, we can conclude that allocating more public resources to the education of children from low-income families will have a positive moderate effect on their educational achievements and can narrow the gap between their scores and those of children from high-income families, but cannot close it completely.

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