

THE EFFECT OF THE LIQUIDITY CONSTRAINT ON THE ACCESSIBILITY OF HIGHER EDUCATION IN ISRAEL¹

YOAV FRIEDMANN AND RONI FRISH

Abstract

The difference in the proportion of students from families with different income levels attending college is due to two factors: the liquidity constraint and the difference deriving from the low returns to education among the poor. We find that grades in the school-leaving matriculation examinations (*Bagrut*) constitute an unbiased estimate of the returns to higher education for men, and can be used to estimate the extent of the liquidity constraint affecting students from an underprivileged socio-economic background. Among women, on the other hand, we find that the returns to higher education for school-leavers with matriculation from underprivileged families are higher than they are for school leavers with matriculation from better-off families, i.e., the liquidity constraint for women is underestimated. We find that 3.3 percent of male school-leavers and 4.5 percent of female school-leavers, both having matriculated from high school, refrained from going on to higher education because of a liquidity constraint. The existence of a liquidity constraint as regards higher education for both men and women is borne out by the longer time it takes for youngsters from low-income families to graduate from college. Despite the existence of a liquidity constraint we did not find that a reduction in university tuition fees had an effect on the composition of those graduating. In our opinion, this expresses the relatively small reduction in tuition fees (relative to the total cost of studying) as well as the relatively short period of time that has elapsed since tuition fees were reduced and our sample, which prevents us from identifying slight changes in the composition of those graduating from university.

1. INTRODUCTION

This study examines whether (and to what extent) low-income groups refrain from entering higher education in Israel because of a liquidity constraint—meaning that the cost of

¹ Bank of Israel, Research Department. <http://www.boi.org.il>; Email: yfree@yahoo.com
Email: roni.frish@boi.gov.il.

The research was implemented in the Research Room of the Central Bureau of Statistics (CBS).

We wish to thank Orly Furman, David Gordon and Anat Katz of the CBS for constructing the database and for providing technical support.

financing the studies of individuals who do not have capital (the interest on loans) is higher than it is for individuals with capital (the interest on deposits). Since low-income individuals do not have capital they have to finance investment in higher education by taking loans, which often makes investment in studying not viable, and prevents some of them from studying (in many cases they are unable to obtain any loan). One of the expected results of a liquidity constraint is that the wages of (low-income) educated borrowers are above average, as only for particularly talented individuals with a liquidity constraint and high returns to studies is it worth financing studies by loans. The existence of a liquidity constraint which prevents low-income individuals from acquiring higher education expresses a market failure (an inefficient capital market), which justifies active government policy to resolve the problem, for example by providing subsidized loans for students or graduated tuition fees. Hence, estimating the extent of the phenomenon has important implications for public policy.

Economists tend to treat the acquisition of higher education as purely an investment decision. An individual decides to study if the expected returns on his/her investment in human capital are greater than his/her capital cost.² Thus, the gap in rates of attendance at institutions of higher education between persons with high and low incomes can be divided into two: the gap due to the higher cost of financing academic education, namely, from the fact that the cost of raising capital (the interest rate) is higher for low-income persons than it is for those with a higher income (persons with capital), and another gap deriving from the fact that acquiring higher education increases the salary of low-income persons by a lower rate than it does that of others because of the differences in ability that have accumulated over the years (including inborn abilities). The accepted way used in the literature to isolate the effect of the liquidity constraint on the extent of attendance at institutions of higher education is to compare learning rates among low-income and higher-income persons who have similar achievements in the school-leaving examinations (e.g., Ellwood and Kane, 2000), or in I.Q. tests (Carneiro and Heckman, 2003). The underlying assumption is that these grades predict the returns to education in the labor market. However, the returns to education of low-income students are likely to differ from those of other students (who are not low-income) with similar achievements in the matriculation examinations, so that the results of research studies which adopt this approach could be biased. For example, there may be higher returns to higher education for low-income students with similar matriculation results because they compensate for economic deficiencies by their (inborn) abilities or by higher motivation – qualities which could produce a greater reward in the labor market (while the parents' inputs are of greater importance for high-school students), in which case the liquidity constraint will be underestimated. Another possibility is that given a similar I.Q. low-income individuals will have lower returns to education because of under-investment in education at younger ages

² It is assumed that the decision by a school-leaver to continue studying will take only the expected returns to the acquisition of an academic education into consideration, and will not be dependent on his/her economic situation. However, the family's economic situation has an indirect effect on the returns to human capital, as investment in education at a younger age develops abilities and even directly increases the chances of being accepted into prestigious faculties, which are characterized by greater returns to education. However, in the absence of a liquidity constraint the effect of the individual's economic situation on his/her decision to study does not differ from that of their returns to human capital.

(paucity of employment opportunities), in which case the effect of the liquidity constraint will be overestimated.³

In this study we examined whether achievements in the matriculation examinations are a consistent index of the returns to education in the labor market.⁴ We find that among male students the matriculation results are a consistent index: the returns to education of low-income students are no different from those of higher-income students with similar matriculation results. On the other hand, the returns to education of low-income female students are higher than those of other female students with similar matriculation results – apparently because of the existence of another variable (not anticipated by us) which attests to the individual's abilities and is correlated with the family's economic situation even given similar matriculation results. Hence, in the absence of a liquidity constraint we would expect the attendance rates of low-income women to be higher than those of other women with similar matriculation results, and that the attendance rates of low-income men would be the same as those of higher-income men with similar matriculation results.

Using matriculation grades as a proxy for the expected returns to a degree produces the following results: the higher education attendance rates of high-school graduates whose family income were lower than the median was 6 percent lower than those of students with similar results from better-off families (in the upper quartile of the income distribution). The gap is greater among female high-school graduates, 7.8 percent, and in addition this rate, as stated, underestimates the effect of the liquidity constraint. We also examined the effect of the liquidity constraint on the deferment of age of graduation from university, on the assumption that the deferment of studies reduces the returns to education, so that it is a necessity arising from the liquidity constraint. We found that male and female students from families in the lowest quartile of the income distribution who graduated from university completed their studies about five months later than comparable students from better-off families.

In the final part of our study we examined how a reduction in tuition fees affects the higher-education attendance rate of persons with a liquidity constraint. A change of this kind occurred in the 2001-2002 academic year, in the wake of the recommendations of the Vinograd Committee, which examined tuition fees in institutions of higher education. The Committee recommended a gradual overall reduction of tuition fees by 50 percent: by 14 percent in the first year and 9 percent over the subsequent four years. In effect, the tuition fees were reduced by 14 percent in the 2001-2002 academic year, and by another 3 percent in the three subsequent years. We found that graduates in the 2004-2005 academic year, who benefited from the reduction in tuition fees over three years, did not differ from graduates who preceded them as regards such socio-economic characteristics as number of

³ Biases of this kind could explain the fact that Ellwood and Kane find that the liquidity constraint has a considerable effect, while Carneiro and Heckman find that it has only a slight effect.

⁴ Unfortunately, we do not have data on the results of the psychometric tests for individuals, and therefore cannot use them, but this does not alter the results of the study. For example, if high-income students have higher average intellectual ability than low-income students with the same matriculation results, their superior ability will be expressed in higher returns to a degree (higher salary) as well as in their psychometric grades. Since we are examining the rates of higher education among students with the same returns to a degree, we also neutralize differences in ability that are not grasped by the matriculation examinations.

siblings, father's income, and ethnic origin. This contradicts the assessment that the rate of tuition fees and a liquidity constraint affect the attendance rate of lower-income strata. Note, however, that we do not have data on university graduates from later years who benefited from the reduction in tuition fees, and that these data may have changed the picture because the downward path of tuition fees announced by the government might have caused some persons with a liquidity constraint who intended to study to defer the start of their studies for some years, in the expectation of a further reduction. It is also possible that the effect of the reduction in tuition fees on persons with a liquidity constraint who had not originally intended to study may not have been immediate, and it may have taken several years for them to internalize it.

This study comprises seven sections. The second is a brief review of the literature, the third presents our research strategy, the data file, and basic facts; the fourth estimates the effect of a liquidity constraint on higher-education attendance rates, and also examined the deferment of studies among persons with a potential liquidity constraint. The fifth section estimates the premium on a first degree for persons with and without a liquidity constraint. The sixth section examines how the reduction of tuition fees following the recommendations of the Vinograd Committee affected the composition of persons attending institutions of higher education. The seventh section concludes and summarizes the article.

2. A BRIEF REVIEW OF THE LITERATURE

Many empirical studies (mainly in the US) have estimated the effect of a liquidity constraint on the acquisition of higher education, but the discussion as to the nature of this effect is still unresolved. Kane (2001) conducted an extensive review of the empirical evidence on this subject and reached the following conclusion:

“In summary, even though there are a number of pieces of evidence that would be consistent with borrowing constraints, it is difficult to find a definitive test of the existence of borrowing constraints in the literature. In each case, there are alternative explanations for the same facts... Although the answer is fundamental to any consideration of social benefits of further investments in training, many pieces of evidence would be consistent with either interpretation.”

Among the studies providing evidence for the existence of a liquidity constraint we first note those which examined the causal link between education and salary. These studies find that students who were obliged (or encouraged) to study for an additional year under the Free Compulsory Education Law benefited considerably from their studies (for a review of the literature, see Card, 2001). This benefit was not less than the average returns to education. The high returns to education obtained by students who were obliged (or encouraged) to study indicates that those students had a liquidity constraint, as the return they obtained was far higher than that from investment on a risk-free asset. Similar results were obtained in studies which examined the effect of the Free Compulsory Education Law in Israel (Frish, 2007, Kriaf, 2008).

Other studies examined whether an increase in tuition fees in institutions of higher education in the US affected students from low-income families to a greater extent than it did those from higher-income ones. McPherson and Schapiro, 1991; and Kane, 1994, found that an increase in tuition fees causes mainly students from low-income families to refrain from attending institutions of higher education, attesting to the existence of a liquidity constraint. On the other hand, Cameron and Heckman, 1998, did not find that an increase in tuition fees caused low-income students to stay away from higher education; they did find that the effect of a hike in tuition fees on low-income students was no different from that on higher-income students – and came to the conclusion that a liquidity constraint had a negligible effect. Additional evidence of the negligible effect of the liquidity constraint was provided by a study of a program of grants (Pell Grants) (e.g., Kane, 2006b), which was intended to help families in the lower quartile of the income distribution, *inter alia* by means of a study grant.⁵ Evidence in the opposite direction is found in Kane (1996a), namely, that in US states where tuition fees are higher students tend to defer the start of studies. In his opinion, the deferment of studies is caused by lack of choice, as it reduces the returns to studies and therefore attests to the existence of a liquidity constraint.

Several studies have examined higher-education attendance rates in the US with regard to the economic background of parents and the ability of students. Ellwood and Kane (2000) pointed to the large gaps in college attendance between low-income and higher-income persons in the US and found that these gaps remained significant even when students with similar high-school achievements were compared. On the other hand, Carneiro and Heckman (2002, 2003), who examined the same phenomenon with the aid of the AFQT test, found that the effect of economic status on college attendance was negligible, while the ability to study had a marked effect. In their view, the gap between the higher-education attendance rates of low-income and higher-income individuals stemmed mainly from the poorer abilities of the low-income individuals as a result of underinvestment in their education at a younger age (which they define as a long-term liquidity constraint). They claim that the effect of a short-term liquidity constraint is not great, and that this is proved by the fact that a rise in the income of the parents of low-income students at the end of their high-school studies does not increase their higher-education attendance rates.⁶ A similar conclusion is reached by Friedmann (2007), who examined the effect of the liquidity constraint on higher-education attendance rates in Israel. Friedmann used matriculation results as an index of the ability to study, and parents' income as an index of a liquidity constraint, and found that about 3 percent of high-school graduates in Israel refrained from obtaining higher education because of a liquidity constraint.

⁵ A possible explanation of this result is that the effect of a reduction in tuition fees is greater than that of an increase in the grants budget because of a lack of information and risk-averseness (Kane, 2001).

⁶ In an extensive review, Carneiro and Heckman (2002) reject much of the evidence supporting the existence of a liquidity constraint, including that regarding the high returns to education cited by Card (2001).

3. THE RESEARCH STRATEGY, DATABASE, AND STYLIZED FACTS

a. The liquidity constraint: the question of identification

We briefly present the theoretical model that explains attendance at an institution of higher education, while emphasizing the main assumption that enables identification of persons with a liquidity constraint. We assume that after high school all individuals have to decide whether to continue their education or enter the labor market. In accordance with the approach accepted in the literature, we assume that the decision to continue studying is a function of the returns to studies, which are dependent on the individual's ability,⁷ the cost of studying, and the interest rate confronting potential students.

$$(1) \quad S_i = \begin{cases} 1 & \mu \left(\Delta Y_i^+(A_i), \bar{C}, \bar{r}_i \right) \geq S^* \\ 0 & \text{else} \end{cases}$$

Where

S_i is the variable which takes the value 1 if the individual enters higher education.

$\Delta Y_i(A_i)$ is the incremental salary of an individual i if he/she studies, and is contingent on the individual's ability, A_i

C is the tuition fee

r_i is the interest rate confronting the individual i

According to the assumption, some individuals will choose not to study because of the high interest rate confronting them; these are the individuals with a liquidity constraint. Other individuals will choose not to study because of the low premium for studying or the high tuition fees. Identifying individuals with a liquidity constraint requires distinguishing between qualities which affect the premium on a degree for the individual and qualities which attest to the interest rate confronting the individual. Some of the qualities which characterize an individual's ability are not perceptible, while most of those which are perceptible are consistent with both his/her ability and their economic situation. Since we have individuals' matriculation examination results, which are a major indicator of ability (and of the premium on a degree), on the one hand, and parents' income, which is expected to have a clear-cut correlation with the interest rate confronting the individual, on the other, we refer to these qualities, as specified in the theoretical discussion below.

⁷ Ability may be a combination of many qualities.

We first assume that the individual's matriculation examination result, Z_i , and the interest rate confronting him/her maintain the following simple relationships⁸:

$$(2) \quad Z_i = \eta(A_i, B_i) + u_i$$

$$(3) \quad r_i = v(X_i) + v_i$$

Where B_i is the individual's background qualities (which are not parents' income), X_i is parents' income, and u_i, v_i are random noises maintaining $E(u_i) = 0$ and $E(v_i) = 0$. On the basis of equation (2) and the assumption that the premium on a degree depends solely on the individual's ability as described by A_i , the following will obtain:

$$(4) \quad E(\Delta Y_i | Z_i, B_i) = E(\Delta Y_i | Z_i, B_i, X_i),$$

meaning that the expected premium on a degree, given the matriculation examination result and other background qualities of the individual, is independent of parents' income. Since we assume that the interest rate confronting the individual is a function of parents' income only, therefore:

$$(5) \quad r_i \perp \Delta Y_i | Z_i, B_i.$$

This means that the interest rate confronting the individual is not dependent on the premium on a degree given the matriculation examination results and other background qualities (which are not parents' income) of the individual. This separation between the interest rate, which is a function of the individual's economic situation, and the premium on the individual's degree makes it possible to identify those with a liquidity constraint by means of matriculation examination results, additional background data on the individual, and parents' income. This approach was adopted by Elwood and Kane and Carneiro and Heckman, as well as by Friedmann with respect to Israel.

According to this approach, one of the reasons for bias in estimating the liquidity constraint may be due to the fact that the simple relations presented in equations (2) and (3) do not exist in real life. It is possible to think of a more complex function, according to which the matriculation result is determined directly by parents' income. An example of this is help in studies through private tuition, which influences matriculation examination results. Another example is the fact that low-income individuals who know that their chances of going on to higher education are low, because of the liquidity constraint, do not invest in their high-school studies, so that their matriculation examination results are poorer. We can write this complex function as follows:

$$(2)' \quad Z_i = \eta(A_i, B_i, X_i) + u_i.$$

⁸ This structure of the interest rate specifically assumes that additional background variables of the individual (such as parents' education and place of residence) are not relevant for the interest rate confronting him/her.

In this case the parity presented in equation (4) will no longer obtain, and there will be a correlation between the interest rate confronting the individual and his/her premium on a degree, given the matriculation results and his/her other background variables. As a result of this, the matriculation results do not create a complete distinction between the premium on a degree and the interest rate confronting the individual, so that estimating the extent of the liquidity constraint on the basis of an analysis of the extent to which individuals with similar matriculation examination results and different economic backgrounds enter higher education will be biased. Another bias in estimating the liquidity constraint may derive from the fact that the data available to the researcher do not make it possible to fully adjust for the correlation between the liquidity constraint (the interest rate) and the premium on the individual's degree. This is the case even if the relationships described in equations (2) and (3) obtain. For example, if the researchers have partial data regarding Z (matriculation results), they may tend not to identify the premium on a degree, so that part of the gap in consumption of higher education will be ascribed to a liquidity constraint even though it derives from gaps in the premium on a degree. In this case, the estimation of the liquidity constraint will be biased upwards.⁹ Using the salary data available to us, in Section 5 we examine whether the hypothesis in equation (4) obtains, i.e., whether, given matriculation examination results and parents' education, the premium on a degree is identical for population groups from different economic backgrounds.

b. The data file

Our data consist of detailed information on about half of the 1974-1977 cohort, chosen at random. For each of the individuals in our sample we have information from the population census such as date of birth, religion, number of siblings, and place of residence.

The census data were matched by the Central Bureau of Statistics (CBS) with three administrative data files as well as with the 1995 census (by means of the student's identity number).

1. A file of students who took the matriculation examinations in the period from 1992 to 1996. The file contains full information about matriculation examination grades, extent of studies, and learning track. For students in the technological track the information is only partial, consisting solely of the number of units in the various matriculation examinations.

2. A file of students graduating from universities and colleges in the period from 1995 to 2005. The file contains information about all the graduates (excluding those graduating from teachers' training colleges), information about the nature of the degree (first or second degree, etc.), institution of higher education, subject studied, and year of graduation.

3. A file from the National Insurance Institution containing full information about the labor income of wage-earners and self-employed persons in 2004, and information about the labor income of wage-earners in 2005. This file includes information about the wage income of the 1974-1977 cohort and their parents.

⁹ On the other hand, errors in measuring parents' income could lead to a downward bias in the estimation of the liquidity constraint, because some of the influence of income will be attributed to the gap in students' achievements.

4. The population and housing census of 1995. This census contains information about the households of the parents of the 1974-1977 cohort when the individuals concerned were aged about 20. The information includes parents' education, their wages in September 1995, their place of residence, etc. In contrast with the administrative files (mentioned above), this file includes information for only 30 percent of our sample, as the obligation to answer the extended questionnaire applied to only 20 percent of the population.

Table 1
Jews Born in 1974* by High-School Matriculation, First Degree, and Employment in 2005 (percent)

	Total	First degree completed**	Employed and self-employed persons in 2004***	Persons employed for 10 months or more in 2005
Total	32,675	25	74	50
High-school graduates	23,603	33	81	56
General high school	13,581	48	81	57
Technological high school	5,242	22	81	60
No matriculation	4,780	3.3	79	51
Did not complete high school	9,072	4.7	55	34

* Individuals born before 30 Kislev 5735 (14 December, 1974), the cut-off date for school entry in the 1979-1980 school year.

** Individuals who completed at least one degree in Israel by 2005, excluding teachers' training colleges.

*** Individuals with some labor income in 2004. The proportion of self-employed persons without wage income in this file was only 6 percent.

The data file is unique, and hence we will describe it in greater detail. Table 1 shows the distribution of Jews (men and women) born in 1974, by high-school graduation, completion of first degree, and employment in 2004 and 2005.¹⁰ Some 72 percent of the cohort were identified as high-school graduates, the remaining individuals were not found in the file of high-school graduates for two main reasons: they had dropped out of school (from the statistical report it transpires that more than 15 percent dropped out of high school in the 1990s), or because they were not in Israel when they were of high-school age. Some 50 percent of the individuals in the sample had been employed for ten months or more in 2005, and about 24 percent had been employed or self-employed for between 1 and 9 months.

Table 1 also shows the higher rate of first degree graduates among students from general high schools than among those from technological high schools. This is hardly surprising because only 2 percent of the individuals who completed high school but did not take a single matriculation examination graduated from an institution of higher education. About 7.4 percent of those who were not in the matriculation examination file graduated from an institution of higher education in Israel. It is reasonable to assume that some of them were abroad for part of their high-school studies.

¹⁰ All the data in this study include youngsters from families where the parents shared the same household in 1995, provided that they constituted over 90 percent of the youngsters in the sample. Immigrants who arrived in Israel after the age of 15 were omitted from the study.

c. Stylized facts

We first present descriptive statistics of high-school graduates, distinguishing between those who graduated from an institution of higher education and those who did not, on the basis of matriculation examination results, as well as parents' education and income. Table 2 shows the proportion of first degree graduates and the premium on a degree, as well as socio-economic characteristics of Jews born in 1974-1975 who completed the general high school track by matriculation examination grade. As the table shows, the relationship between a student's success in the matriculation examination and his/her family background is apparent: *on average, the income of fathers of students with a better matriculation examination grade is higher, the mother has a higher level of education, and the number of siblings is smaller.* In addition, it can also be seen that *the better the matriculation examination grade, the greater the wage premium on the first degree.*¹¹ Thus, for example, the salary of men with a first degree whose matriculation examination grade is between 8.5 and 9.5 is 22 percent higher than that of individuals who are similar to them but do not have a degree, while the wage differential between persons with a matriculation examination

Table 2
Characteristics of Graduates of General High Schools, by Matriculation Examination Grade and Gender*

Matriculation grade	No. of observations	Proportion of graduates	Premium on degree	Father's salary in 1995	Mother's years of schooling	No. of siblings	Proportion of university graduates**	Proportion of science graduates**
Boys								
5.5-6.5	1,196	18%	9%	7,576	12.0	3.7	46%	24%
6.5-7.5	2,387	31%	15%	8,815	12.6	3.5	55%	36%
7.5-8.5	2,979	48%	17%	10,662	13.3	3.4	58%	40%
8.5-9.5	2,312	71%	22%	12,659	13.9	3.3	76%	51%
9.5+	1,598	83%	9%	13,242	14.7	3.1	93%	66%
Girls								
5.5-6.5	1,590	11%	11%	7,764	11.2	4.1	78%	9%
6.5-7.5	3,925	30%	14%	9,195	11.7	3.8	73%	11%
7.5-8.5	5,092	53%	16%	9,961	12.7	3.5	77%	17%
8.5-9.5	3,639	75%	31%	11,672	13.6	3.3	81%	27%
9.5+	1,411	92%	37%	14,026	14.5	3.1	94%	41%

* Jews born in 1974-1975 who attended a general high school, whose matriculation examination grade includes the bonus for individuals taking the expanded examination in Mathematics, English, Physics, or Chemistry. The data on father's salary and mother's education are taken from the 1995 census, and hence include a smaller number of observations. The premium on a degree was calculated only for individuals who worked for at least ten months in 2004-2005, excluding those who completed a second degree, and on the basis of their salary in 2005.

** First, second, or higher degree.

¹¹ The premium on a degree shown in the table does not take into account the greater seniority of persons without a degree than of those with a degree, and hence constitutes an underestimate of the returns to education.

grade of between 5.5 and 6.5 with a degree and those without one is only 9 percent. This correlation is not surprising, because a high matriculation examination grade expresses greater abilities, and even enables those with these grades to enroll in prestigious faculties. As the table shows, the probability that men with high matriculation examination grades will attend university and study science courses is higher, while there is a greater probability that those with lower matriculation examination grades will attend colleges. Studying in a prestigious faculty enables individuals with high matriculation examination grades to acquire knowledge which has greater value on the labor market, so that for them the premium on studying is higher.¹² The table also shows that *the higher the matriculation examination grade (and the higher the premium on a degree), the greater the probability of completing a degree*, and this is consistent with the basic assumption of this model.

Table 3 compares individuals with similar matriculation examination results with and without a degree. Persons with a degree were found to have a better socio-economic background: the father's income and mother's education were higher, and the number of siblings was lower. The differences in father's salary and the number of siblings are evident among the women, whereas among men significant differences were found only in a few cases. While Table 3 compares persons with and without a degree with similar matriculation examination results, the last three columns show that the matriculation examination results of individuals with a degree are better than those of individuals without one: a large proportion of individuals with a degree took the expanded mathematics matriculation examination, and the number of units in their matriculation examinations was greater (not shown in the table).

Table 3
Differences Between Degree-Holders and Non-Graduates, by Matriculation Examination Grade and Gender¹

Matric grade	Father's salary, NIS '000, 2005			Mother's years of schooling			No. of siblings			Proportion of individuals taking expanded mathematics examination		
	With degree	W'out degree	Diff.	With degree	W'out degree	Diff.	With degree	W'out degree	Difference	With degree	W'out degree	Diff.
Boys												
6.5-7.5	128	119	7%	13.1	12.4	0.7*	3.5	3.6	-0.1	38%	18%	20*
7.5-8.5	145	128	13%	13.2	13.1	0.1	3.3	3.5	-0.2*	67%	46%	21*
8.5-9.5	171	160	7%	14.2	13.6	0.6	3.2	3.3	-0.1	93%	84%	9*
Girls												
6.5-7.5	119	95	25%*	11.7	11.5	0.2	3.6	3.8	-0.2*	21%	11%	11*
7.5-8.5	130	108	20%*	12.9	12.0	0.9*	3.4	3.7	-0.3*	45%	27%	18*
8.5-9.5	141	139	2%	13.5	13.0	0.6	3.2	3.8	-0.5*	75%	60%	15*

¹ Because of the low number of university graduates with a matriculation examination grade of 6, and of non-graduates with a matriculation examination grade of 10, they do not appear in the table.

* Statistically significant at the 5 percent level.

¹² The premium on a degree among men with a matriculation examination grade that is higher than 9.5 was found to be low (only 9 percent), due to the fact that the number of observations of individuals who did not complete a degree was small.

In order to compare individuals with a first degree and those without one whose matriculation examination results were similar, we constructed an index of success in the matriculation examinations. This index is based on detailed information about the matriculation examinations and not only on the average grade. The index includes, inter alia, the total number of study units in the matriculation examination and the number of study units and grades in science subjects, which are considered to be more difficult. The weights of the various variables in the index were determined on the basis of their influence on the probability of completing a degree. We ran a Logit regression, in which the dependent variable is a dummy variable for obtaining a degree, and the explanatory variables are the grades in the various matriculation examinations and the number of study units in English, Mathematics, Physics, Chemistry, and Biology. Controlling for the quality of matriculation examination results enables us to check whether socio-economic background affects the individual's decision to study beyond its influence on success in the matriculation examinations.

A comparison of homogeneous groups with regard to success in the matriculation examinations (Table 4) shows that father's income for individuals with a degree is higher (in 2005)¹³ and the number of siblings is lower; in most cases the differences were found to be significant. With regard to mother's education, however, there was no clear-cut pattern: for individuals with middling or lower matriculation examination results we found that mother's education was higher for those with a degree, while for individuals who had good or very good matriculation examination results and had a degree the mother's level of education was lower. *This preliminary evidence suggests that the effect of father's income*

Table 4
Differences Between Individuals With and Without a Degree as Regards Father's Income, Mother's Years of Schooling, and Number of Siblings, by Gender and Matriculation Examination Result

Matriculation result	Boys			Girls		
	Father's income	No. of siblings	Mother's schooling (years)	Father's income	No. of siblings	Mother's schooling (years)
Poor	42%* (2.8)	-0.2* (-3.2)	0.9* (3.9)	16%* (2.4)	-0.3* (4.4)	1.0* (5.6)
Middling	8% (1.6)	-0.1 (1.5)	0.2 (1.5)	17%* (4.0)	-0.2* (4.7)	0.4* (3.1)
Good	10%* (2.2)	-0.1* (1.9)	-0.2 (1.3)	11%* (3.4)	-0.1* (2.5)	-0.7* (6.8)
Very good	12%* (3.2)	-0.2* (5.0)	-0.3* (2.3)	1% (0.2)	-0.2* (5.2)	-0.4* (3.1)

* Significant at the 5 percent level, t-values in parentheses.

Matriculation results were calculated separately for boys and girls on the basis of the probability of completing a degree for graduates of general high schools. The students were divided into quartiles according to the quality of their matriculation examination results: very good, good, middling, and poor.

¹³ Because of the small number of observations for father's income in 1995 (less than 30 percent of the sample), we used father's income in 2005. Appendix Table 2 presents the correlation between income groups in 1995 and 2005.

and the number of siblings – which together indicate per capita income – has more influence on the decision to study than that of success in the matriculation examinations, while the mother's education has no such influence.

At the next stage we divided father's income in 2005 by the number of persons in the family, and divided the families into four groups by per capita income—high, above average, below average, and low. *We found that the probability of obtaining a degree declines as per capita income falls, and that this difference is particularly great for those with middling matriculation results.* The difference in the proportion of university graduates among boys with a middling matriculation examination result from families in the lowest quartile of the distribution and that of those from the top quartile was 10 percentage points. The difference was greater for girls – the proportion of women graduates from families in the lowest quartile of the per capita income distribution was 15 percentage points less than that of women with similar matriculation examination results from families in the top quartile (Table 5). A significant but smaller difference was found in the proportion of university graduates among students with good and very good matriculation examination results.

Table 5
Proportion of First Degree Students and the Premium on a First Degree, by Success in Matriculation Examinations, Per Capita Income, and Gender
Per capita income (percent)

	High		Medium-high		Medium-low		Low	
	Proportion of graduates	Premium on degree	Proportion of graduates	Premium on degree	Proportion of graduates	Premium on degree	Proportion of graduates	Premium on degree
Boys								
Middling	40	5	37	16	33	1	30	8
Good	61	12	62	22	59	17	53	31
Very good	83	29*	81	13*	78	42*	77	17
Girls								
Middling	46	4	40	6	35	16	31	15
Good	65	5	67	3	56	16	55	23
Very good	88	44	85	21	83	30	83	43

* The number of observations of those studying for a first degree or without a degree was less than 60.

Another interesting result shown in Table 5 is that *girls from families with a low per capita income generally obtained far better returns to a degree than their equivalents from better-off families*, and this was primarily the case for girls with middling and good matriculation examination results. Among boys this phenomenon was less apparent, and can be identified only among those with good matriculation examination results. This result indicates that the returns to a degree are influenced not only by individuals' matriculation examination achievements but also by their economic situation.

The lower proportion of individuals with a degree from low-income families, for all groups of matriculation examination results, enables us to obtain an estimate of the effect of the liquidity constraint. The higher premium on a degree obtained by girls from low-income families indicates that the estimation, which is based on the difference in the proportion of individuals with a degree in all groups of quality of matriculation examination results, could be an underestimate. We assume that the higher returns to a degree among girls from low-income families derive from their high motivation and ability relative to those of girls with similar matriculation examination results but from better-off families. Their superior motivation and ability helped them to compensate for their economic disadvantages and obtain similar matriculation examination results and to succeed at university, and in the labor market. These qualities assumed greater importance (the disadvantages lost significance), so that in the final event the premium on a degree is greater for them than it is for individuals with a degree and similar matriculation examination results, but whose economic background is more comfortable. In order to obtain a full estimation of the effect of the liquidity constraint it is necessary to compare individuals with a similar premium on a degree and different economic backgrounds. Before estimating the effect of the liquidity constraint we examine the hypothesis that the premium on a first degree for men and women from low-income families is significantly greater than it is for the rest.

4. THE EFFECT OF THE LIQUIDITY CONSTRAINT ON INVESTMENT IN EDUCATION AND THE DATE OF COMPLETION OF STUDIES

a. The liquidity constraint and investment in education

In this section we estimate the effect of the liquidity constraint using the method adopted by Elwood and Kane and Carneiro and Heckman, and by Friedmann for Israel. The data available to us are better than those used by Friedmann: we conduct a follow-up of the high-school graduates until they are 30-31, compared with the 27-28 age-group available to him; this represents an additional three years which are particularly important in following-up men, who generally obtain their first degree at the age of 27-28. The sample includes Jews born in 1974-75 who attended a general or technological high school.

We estimate the extent of the liquidity constraint among graduates of the general high-school track. This estimate is the difference in the probability of obtaining a first degree between individuals from high and low per capita income families with similar matriculation examination results. As stated, these results represent the premium on a degree, while per capita income, calculated as father's income in 2005 divided by the number of persons in the family, represents the liquidity constraint. We first use a Logit regression to estimate the probability of completing a first degree on the basis of matriculation examination results among individuals from families with high per capita income (from the top quartile of per capita income distribution). Assuming that this group does not have a liquidity constraint, we use the regression coefficients of this group to estimate the expected proportion of university graduates among the other groups in the

population, given the matriculation examination result and absence of liquidity constraint. The estimate for the liquidity constraint is the expected difference in the probability of completing a first degree derived from the regression coefficients of the low-income population, on the one hand, and the actual proportion of university students, on the other. The estimation was calculated separately for graduates of the general high-school track only, because we did not have the matriculation examination results of graduates of the technological high-school track, and the estimations for them could be based solely on the number of study units in the various subjects.¹⁴ The results are given in Table 6.

Table 6
Estimation of the Liquidity Constraint Among General High-School Graduates, on the Basis of Per capita Income, Matriculation Examination Results, and Gender
(percent)

	Boys			Girls		
	Actual proportion of graduates	Expected proportion of graduates	Estimated liquidity constraint	Actual proportion of graduates	Expected proportion of graduates	Estimated liquidity constraint
Per capita income	60.1	60.1	--	64.7	64.7	--
Top quartile	53.3	54.5	1.3	55.1	57.4	2.3*
Second quartile	42.7	47.0	4.3*	43.0	49.7	6.7*
Third quartile	36.6	44.3	7.7*	39.4	48.2	8.8*
Lower half	39.7	45.7	6.0	41.2	49.0	7.8

*Significant at the 5 percent level (not taking into account the fact that the expected proportion of graduates is estimated from the regression).

Jews born in 1974-1975. Separate distribution of income quartiles for boys and girls. Number of observations per quartile: 2.150 boys, and 3.000 girls.

The results of the estimation show that the liquidity constraint is a greater obstacle to obtaining education for girls than it is for boys. Among graduates of the general high-school track (Jews only) 4.4 percent of the girls and 3.3 percent of the boys refrained from studying because of a liquidity constraint. Among female graduates of the general high-school track from families with per capita income which was below the median, 8.7 percent refrained from studying, while among male graduates of these schools from low-income families 6 percent refrained from studying. As will be shown below, we believe the estimation of the liquidity constraint for women is an underestimate.

Table 7 shows the actual and expected proportion of general high-school graduates, both boys and girls, from the lowest-income families (the bottom quartile) by matriculation examination results. The relation between matriculation examination results and the effect of the liquidity constraint on attendance at an institution of higher education among low-income families is evident. The effect of the liquidity constraint can clearly be seen among female high-school graduates with middling matriculation examination results. However,

¹⁴ The missing information about matriculation examination results could create upward bias in estimating the liquidity constraint (see the discussion in Section 3.a). On the basis of the data from the general high-school track, the estimation of the liquidity constraint without the matriculation examination results is 15 percent higher than the estimation including them.

among female graduates with very good or poor matriculation examination results the effect

of the liquidity constraint was relatively moderate. Among males the liquidity constraint was found to have a more uniform effect with respect to matriculation examination results, although here, too, most of the difference was among those whose results were middling.

Table 7

Estimation of the Liquidity Constraint Among General High-School Graduates from the Bottom Quartile of the Income Distribution, by Quality of Matriculation Examination Results* and Gender (percent)

Quality of matriculation examination results*	Boys			Girls		
	Actual proportion of graduate	Expected proportion of graduates	Estimated liquidity constraint	Actual proportion of graduates	Expected proportion of graduates	Estimated liquidity constraint
Poor	14.0	8.5	5.5	8.3	12.3	4.0
Middling	37.8	39.2	8.6	27.0	37.9	10.9
Good	49.4	59.5	10.1	45.0	60.2	15.2
Very good	73.7	80.3	6.6	76.5	82.4	5.9

* The quality of matriculation examination results was calculated separately for boys and girls on the basis of the probability of completing a first degree among graduates of the general high-school track from the upper quartile of the income distribution. The quality of the matriculation examination results was defined as very good if the probability of completing a first degree (according to the matriculation examination results of the top quartile) was higher than 70 percent, good if the probability was 50-70 percent, middling if the probability was 30-50 percent, and poor if the probability was less than 30 percent.

b. Deferment of studies and the liquidity constraint

The liquidity constraint causes individuals to refrain from studying and to defer studies. Someone who chooses to study does so on the basis of the assessment that his/her utility from studying will be higher than the cost. In such cases, any deferment of studies reduces the benefit from them. Kane (1996a) found a positive relation between the level of college tuition fees and the age at which studies were begun in the US. The relation was found to obtain for both colored and white individuals, and among white persons a differential effect was found in accordance with the family's source of income. Kane regards these results as indirect evidence of the existence of a liquidity constraint.¹⁵

The data available regarding the year in which an individual obtained his/her first degree enables us to examine whether the family's economic situation affects age of graduation, serving as indirect evidence of the existence of a liquidity constraint. As in the

¹⁵ Another approach to the deferment of studies is presented by Rubinstein and Tsiddon (2004), who state that in a world of rapid technological change and the individual's uncertainty as to his/her personal returns to studies it is likely that entry to higher education will be deferred. According to this approach, too, the deferment of studies whose aim is the acquisition of information about the returns to studying before making an investment which is irreversible for young people from low-income families could indicate the existence of a liquidity constraint. The explanation for this is that the investment in studies for youngsters with a liquidity constraint is relatively expensive, and hence obliges them to exercise particular caution before investing in studies—in other words, to defer studying until they have sufficient information to make the investment worthwhile.

previous sections, we divided the population into four groups by father's income divided by the number of persons in the family, and we examined the length of time until the degree was obtained as a function of the economic situation given the individual's potential to obtain a degree (measured by matriculation examination results).

The time until completion of a degree was estimated in two ways: 1) A parametric estimation using OLS (Ordinary Least Squares) regression in which the dependent variable is the age at which the degree is obtained, and the explanatory variables are the individual's matriculation examination results and the family's income group; 2) An a-parametric estimation using Propensity Score Matching (PSM), in which each individual in the lowest three income groups was matched with an individual with an equal probability of studying from the highest income group, and we tested the hypothesis that there is a significant gap in the average age of completing a degree between individuals from the various income groups.

Table 8 shows the average difference in years of study between individuals from the lower income groups and those from the highest income group, for both boys and girls. As can clearly be seen from the table, there is a difference of 4.0 years in the time it takes for individuals from the lowest income group and those from the highest income group to complete a degree. The results of both the parametric and the a-parametric methods are similar, attesting to their stability. Note, too, the similar difference between the group of girls and boys despite the difference in the proportion of those studying for a degree and the length of time it takes to complete a degree, reinforcing the assessment that the difference expresses similar difficulties for boys and girls.

Table 8
The Time Difference (in Years) Until Completion of First Degree, by Father's Per Capita Income in 2005 and Gender

Quality of matriculation examination results*	Boys			Girls		
	Low	Medium-low	Medium-high	Low	Medium-low	Medium-high
OLS	**0.36 (0.079)	0.11 (0.075)	0.07 (0.070)	**0.39 (0.059)	0.02 (0.057)	0.04 (0.052)
P.S.M	**0.44 (0.11)	0.11 (0.11)	0.05 (0.10)	**0.40 (0.089)	0.00 (0.086)	-0.03 (0.075)

* The dependent variable in the OLS regression is age upon completing degree; the number of observations was 3,934 for boys and 5,728 for girls, Jews, graduates of the general high school track only. The explanatory variables are average of matriculation examination results, total study units, dummy variables for study units in Mathematics and English, study units in Physics, Chemistry, and Biology, dummy variables for year of birth and year of graduating from high school, as well as dummy variables for per capita income according to father's income, based on father's income in 2005. The data reported in the OLS regression are the coefficients of the regression of the dummy variables of the group of parents' income. Changing the control variables attributed to matriculation examination results and/or adding parents' education does not affect the estimations of the coefficients of the dummy variables for the income group of father's income. The same applies to substituting father's income from the 1995 census for the data on father's income in 2005.

Matching using PSM (Propensity Score Matching) was implemented separately between each group of father's income and the groups with high father's income. The matching was undertaken on the basis of the probability of completing a first degree. This probability was calculated by means of a Logit regression, where the explanatory variables are identical with those we used in the OLS regression., except for the use of a variable representing the father's income group. The number of observations in this group relates to the three lowest income groups: 2,743 for boys, and 3,900 for girls.

** Significant at the 1 percent level.

5. THE PREMIUM ON A FIRST DEGREE FOR PERSONS WITH A LIQUIDITY CONSTRAINT

In this section we examine the hypothesis that matriculation examination results constitute an unbiased estimation (proxy) for the returns to education. If the premium on a first degree for low-income individuals is the same as it is for others with the same matriculation examination results, the achievements in the matriculation examinations constitute an unbiased estimation of the returns on education, and so the results obtained in Section 4 are not biased. On the other hand, if the premium on a degree is higher for low-income individuals, the estimations presented in Section 4 are underestimations of the effect of the liquidity constraint. Below we examine the premium on a degree for individuals who are similar with regard to success in high school studies but differ as regards economic background. The index used to measure economic background is per capita income (father's income *divided by* number of persons in family).

We use Propensity Score Matching to calculate the premium on a first degree for Jews born in 1974-75 who studied in a general high school track and worked for a whole year in 2005 (in accordance with E. Leuven and B. Sianesi, 2003). University graduates who completed their university studies after 2003 or completed a second degree were omitted from the estimation. We first estimated the probability of completing a degree given the detailed matriculation examination results and study units.¹⁶ We then divided the sample into two groups, one of families in the lowest per capita income quartile and the other of families in the per capita income quartile above the median (on the assumption that the low-income families represent individuals with a liquidity constraint and that the families with per capita income that is above the median do not have a liquidity constraint). In each of the two groups we matched each individual with a degree with individuals without a degree who were similar to him/her as regards matriculation examination results (as measured by the probability of stadying),¹⁷ the wage gap between persons with a degree and those without one with similar matriculation examination results is the premium on a degree.¹⁸ At the second stage each 'couple' from the lowest per capita income quartile (which includes an individual with a degree and several without one who resemble him/her as regards matriculation examination results) was matched with a couple from the highest per capita income quartile with similar matriculation examination results (yielding 'quartets' with equal matriculation examination results). We thus obtained the premium on

¹⁶ The additional variables included in the estimation were year of birth (correlated with age of school entry) and dummy variables for the correlation between year of completion of high school and age. The estimation did not include father's income or number of siblings. Parents' education was not included as an explanatory variable in the results reported here because this seriously restricted the number of observations. Including parents' education as an explanatory variable in the regression does not significantly alter the individual's probability of completing a first degree given his/her matriculation examination results.

¹⁷ Each individual was matched with up to five similar individuals, provided the gap between them in the probability of completing a degree was less than half of one percent.

¹⁸ Students for whom the probability of completing a degree was less than 10 percent were omitted from the study because of the lack of individuals with a degree in this probability range.

a degree for individuals from the lowest per capita income group (henceforth, the low-income group),

and the premium on a degree for individuals from the highest per capita income group (high-income individuals) who are identical as regards matriculation examination results. We calculated the gap in the premium on a degree between the two groups and examined whether the gap in the premium on a degree between the two groups was significant.

Table 9 summarizes the estimates we obtained using the PSM method: the estimation of the premium on a degree in high-income and low-income families. The estimations were calculated separately for boys and girls. As the table with the results shows, the premium on a degree for women from low-income families is significantly higher than it is for women from high-income families, and there is no difference in the premium on a degree between men from low-income and high-income families¹⁹. The higher premium on a degree for women from low-income families reflects the fact that the salary of women without a degree from low-income families is far lower than that of similar women from high-income families, while there is no such difference among women with a degree. Table 9 shows several additional characteristics of the various groups, among them the considerable similarity in matriculation examination results between women with a degree from low-income families and those with a degree from other income groups – a similarity which is

Table 9
Premium on a Degree,* by Per Capita Income of Family of Origin, and Gender

	With degree	Boys		Girls	
		Low per capita income	High per capita income	Low per capita income	High per capita income
Monthly wage (NIS)	With degree	14,431	15,453	8,894	8,661
	Without degree	12,186	12,231	6,650	7,825
	Premium on degree	2,245	3,222	2,244	834
	Premium gap		-977 (1,040)		1,409 (460)
Matric exam grade	With degree	7.68	7.71	7.67	7.65
	Without degree	7.78	7.74	7.71	7.65
No. of matched 'quartets'**		145		316	
Years to completion of degree		2001.0	2001.0	2000.4	2000.3

The sample population includes Jews born in 1974-75 who attended the general high-school track and worked for a whole year in 2005. Individuals with a first degree who completed their studies after 2003 or obtained a second degree were omitted from the sample.

* The premium on a degree is the wage differential between individuals with a degree and those without one in 2005. The premium on a degree was calculated by Propensity Score Matching for persons with a degree.

¹⁹ We assume that the higher returns for low-income women in the labor market do not derive from differences in hours worked. While it could be the case that men and women with a degree may have been working for longer hours than those without one (so that the premium on a degree in terms of wage per hour is lower than if calculated using monthly wage), for the current conclusion we only assume that the difference in hours worked between individuals with and without a degree is not correlated with parents' economic background. Unfortunately, we do not have data on hours worked, and so cannot verify this assumption.

** Each quartet includes one individual from the group of those where the income of the family of origin is low, have a degree, and have similar matriculation examination results, and one individual from each of the other three groups (individuals with a degree from a high-income family, individuals without a degree from a low-income family, and individuals without a degree from a high-income family).

created as part of the PSM method (apparently matching individuals with similar probabilities of studying according to their matriculation examination results). There is also considerable similarity between the time taken to complete a degree, making it possible to reject the hypothesis that the greater premium on a degree for low-income women stems from their longer presence in the labor market.

Table 10 presents a sensitivity analysis of the difference in the premium on a degree between women who grew up in families with a liquidity constraint and women who did not. The right hand column gives the difference in the premium on a degree when the calculation is based on matches with individuals who studied for a degree, using the method described above. The left hand column shows the same difference in premium but when the matching is done in the opposite way (namely, matching up to five individuals who studied for a degree with each individual who did not study for a degree) The population which did not study for a degree has lower average matriculation examination results (and a lower premium on a degree). The difference between the premium on a degree for low-income females and high-income females who did not study for a degree was much smaller than that between females who did study for a degree. Within the framework of the sensitivity analysis we reduced the group of high-income individuals to include only the highest per capita income quartile, and we then expanded it to include the three upper quartiles; the gap in the premium narrowed, but remained significant (for those who studied for a degree). Another sensitivity analysis focused on individuals whose probability of studying for a degree ranged from 30 to 70 percent, assuming that it was worthwhile for individuals with very good matriculation examination results to study even if they also had a liquidity constraint, while persons with low matriculation examination results would obtain only a low incremental wage from studying, so that it would not be very worth their while to study even if they had capital at their disposal. In this test, too, we found that the premium on a degree among low-income women was greater than it was for high-income women, among both those who studied for a degree and those who did not, and that this was statistically

Table 10

The Incremental Premium on a Degree for Females from the Lowest Per Capita Income Quartile Relative to that for Females from Higher Per Capita Income Quartiles with Similar Matriculation Examination Results

	Gap in premium, studied for degree	Gap in premium, no degree
Bottom quartile vis-à-vis two upper quartiles	1,409 (460)	523 (338)
Bottom quartile vis-à-vis top quartile	1,060 (498)	555 (471)
Bottom quartile vis-à-vis three upper quartiles	1,294 (440)	532 (261)
Bottom quartile vis-à-vis quartiles above median that individuals will study with probability of between 30 and 70 percent	1,017 (495)	1,332 (425)

significant. In similar sensitivity analyses undertaken for men we found that there was no significant gap in the premium on a degree between males from low- and high-income families.

The main conclusion to be drawn from the results in this section is that for males matriculation examination results and the family's per capita income make it possible to separate the premium on a degree for the individual and the interest rate confronting him. For females, however, matriculation examination results do not completely offset the correlation between the premium on a degree and the interest rate confronting them. Thus, the estimations for the liquidity constraint among males obtained in the previous section are unbiased, while those for females, where the estimations of the liquidity constraint were higher, are underestimates.²⁰

One possible explanation of the difference in results for men and women is that men's wages were sampled soon after they obtained a degree, before the full extent of the variance in wages among individuals with a degree (according to talent, motivation, etc.) was revealed, while women's wages were sampled quite long after they gained a degree. Another possible explanation is that women are more influenced by a liquidity constraint than are men, and women's returns on a degree are determined by an unexpected variable (one that is known to the individual but is not observed by us). In this case the liquidity constraint prevents women for whom the returns to education are low from studying (at all levels of matriculation examination results). As a result, there is a larger difference between women students at university on the basis of economic background, and low-income women university students have a higher premium. There may be two reasons for the difference in the effect of the liquidity constraint on men and women: 1) The possibility that work prior to and during university studies, while deferring starting and completing studies, is less attractive for women than for men; 2) The premium on a degree is lower for women.

6. THE EFFECT OF REDUCING TUITION FEES ON THE COMPOSITION OF STUDENTS

²⁰ Under the basic assumption in this section, namely, that the incentive to study for a degree is the returns to education.

McPherson and Schapiro (1991) and Kane (1994) found that an increase in tuition fees causes mainly students from low-income families to leave higher education, and the authors regarded this as evidence of the existence of a liquidity constraint.²¹ In this section we examine whether the reduction in tuition fees in the wake of the recommendations of the Vinograd Committee increased the number of students from low-income families.

²¹ On the other hand, Careiro and Heckman (2002) argued that reducing tuition fees need not necessarily increase the proportion of low-income university students. They claim that a reduction in tuition fees will increase the number of students from high-income families (whose returns on education are low) as well as that of those from low-income families. This contention is weakened considerably when there is a non-financial (ability-dependent) entry requirement; in such cases a reduction in tuition fees will have only a slight effect on the proportion of individuals from high-income families with low returns on higher education attending university.

The Vinograd Committee set up to examine tuition fees in Israel's institutions of higher education recommended the gradual reduction of these fees for first degree students between the 2001 and 2006 academic years, bringing it down by 50 percent in real terms (Table 11). The committee's recommendations were accepted by the government, but implemented only in part. Tuition fees for first degree students were reduced by 14 percent in the 2001-02 academic year, in accordance with the committee's recommendations, but in the subsequent years they were reduced by only 3 percent, and not by 9 percent, as recommended. On the face of it, it is very important to examine the effect of the reduction of tuition fees on the proportion of low-income students, as it directly examines the results of a change in government policy. In actual fact, however, it is difficult to draw hard and fast conclusions from the reduction of tuition fees in the 2001-02 academic year because it was accompanied by the expectation of further reductions in the future. The actual and expected reduction of tuition fees had opposing effects. On the one hand, the reduction made it easier for individuals with a liquidity constraint to study, and it was expected to increase their attendance at institutions of higher education. On the other, the prospect of further reductions in the future was expected to cause low-income students to defer the start of their studies. Another difficulty relates to data limitations, as we do not have data on first degree students who completed their studies after 2005.

Table 11
Actual Tuition Fees – Full and Reduced, 2001-2005 (at July 2000 prices)

academic year	Actual tuition fees for first degree	Tuition fees recommended by Vinograd Committee	Tuition fees for advanced degrees	Actual rate of reduction	
				Actual rate of reduction	Recommended rate of reduction
(percent)					
2000-01	10,463	10,463	10,463	--	--
2001-02	8,997	8,997	10,461	14	14
2002-03	8,683	8,056	10,462	17	23
2003-04	8,373	7,117	10,466	20	32
2004-05	8,059	6,175	10,466	23	41

SOURCE: Report of Vinograd Committee and report of Shochat Committee set up to examine Israel's system of higher education.

Table 12 examines the effect of the reduction of tuition fees in the 2001-2002 academic year on the composition of first degree students. Our hypothesis is that the reduction of tuition fees increased the proportion of graduating students with a liquidity constraint. The table compares graduates who completed their studies in the 2005 academic year with those who graduated in 2003. Students who graduated in 2003 began studying before tuition fees began to be reduced and before the Vinograd Committee began its work (it was appointed in May 2000), while the majority of those who graduated in 2005 began studying after the tuition fees had been reduced. Since our data file contains only those individuals born between 1974 and 1977, those who graduated in 2005 were older than those who graduated in 2003. In order to compare students of the same age who graduated in 2003 with those who graduated in 2005 we reduced the sample to students who graduated in 2005 and were

born in 1976-1977 and students who graduated in 2003 who were born in 1974-1975. The comparison shows that the socio-economic background of the two groups is very similar. In effect, there was no evidence that the reduction of tuition fees increased the proportion of students with a liquidity constraint who obtained a degree. The average number of siblings of students who graduated in 2005 is similar to that of those who graduated in 2003, and the proportion of students among them who came from families originating from North Africa was (significantly) lower. Although the proportion of students from large families (at least 5 children) rose and father's income fell, these differences are not statistically significant. The comparison between students who graduated in 2003 and 2005 does not take long-term trends of change in the composition of the students into account (if such a trend exists). In order to neutralize the trend, we compared students who graduated in 2003 and were born in 1976-1977 with those who graduated in 2001 and were born in 1974-1975. Both groups paid similar tuition fees, so that comparing them makes it possible to 'sanitize' the trend effect. We did not find any evidence of a change in the composition of graduates between 2001 and 2003, indicating that there was no trend change in the composition of students. Finally, both the comparison of the first difference (between those who graduated in 2005 and in 2003) and that of the 'difference in differences' indicate that the reduction of tuition fees after 2002 did not increase the proportion of low-income students among those who graduated in 2005.

Table 12

Characteristics of First Degree Students in 2005 (who paid reduced tuition fees) and Graduates in 2003 and 2001 (who paid full tuition fees)

	Experiment v. control		Control v. control		Difference in differences'	
	76-77	74-75	76-77	74-75	76-77	74-75
Tuition fees	Reduced	Full	Full	Full	Diff in diff	T test
Year degree completed	2005	2003	2003	2001		
Proportion of large families	10.4	10.2	11.3	11.3	0.2	0.003
No. of siblings in family	3.26	3.27	3.26	3.26	-0.01	-0.004
Proportion originally from N. Africa	21.6	23.7	21.9	22.0	-2.0	-0.024
Father's income in 1995	10,612	10,832	11,854	12,113	39.0	0.001
No. of observations	6,712	5,783	8,017	6,998	--	--

7. CONCLUSION

In this study we examined the effect of the liquidity constraint on the acquisition of higher education in Israel, using two methods accepted in the literature. The first compared rates of studying and length of time to completion of studies for a first degree for individuals with a liquidity constraint and those without one with similar matriculation examination results. The second method examined the effect of the reduction of tuition fees in the 2001-2002 academic year on the composition of those studying in institutions of higher education.

The estimation of the liquidity constraint according to achievements at a general high school showed that the chances of students who were raised in low-income households to obtain a first degree were lower than those of students from high-income homes with similar matriculation examination results. In contrast with previous studies, such as those of Elwood and Kane, and Carneiro and Heckman, we did not rush to interpret the differences in the probability of studying between the income quartiles as estimations of the liquidity constraint. We examined the hypothesis implicit in these articles that, given a student's achievements, there is no dependence between the returns on education and the index of the liquidity constraint. This hypothesis was found to be correct with regard to males, but not for females: the returns to education of males from low-income homes was found to be higher than those for females from high-income homes with similar matriculation examination results (among males no significant differences were found). Thus, the differences in study rates between high-income and low-income women (given their matriculation examination results) are underestimates of the liquidity constraint, while these differences are not biased with respect to men.

In this study we find that among Jews the chances of a student from the lowest income quartile to study are 7.7 percentage points lower than those of a student with similar matriculation examination results from the highest income quartile. The difference between women students from the lowest and the highest income quartiles is even greater—8.8 percentage points. There is also a considerable difference in the probability of studying between students from the second and top income quartiles—3.4 percent among men and 7.6 percent among women. Another result indicated by the research, constituting indirect evidence of the existence of a liquidity constraint, is the deferment of the conclusion of studies for a first degree by (Jewish) students from the lowest income quartile. We find that both male and female students from the lowest income quartile defer the conclusion of their studies for a first degree by about five months in comparison with students from the top income quartile with similar matriculation examination results. As the deferment of the conclusion of studies reduces the benefit obtained from them, we can assume that the deferment of studies by low-income students derives from a liquidity constraint. In common with other research studies, we estimated the effect of the liquidity constraint on individuals who completed their high-school education by taking the matriculation examinations, but we did not estimate the effect of the liquidity constraint on individuals who did not complete their high-school education or take a single matriculation examination.

The second method we used for estimating the effect of the liquidity constraint on the accessibility of higher education was by examining the effect of the reduction of university tuition fees on the composition of students. In the 2001-2002 academic year the tuition fees in institutions of higher education were reduced by 14 percent, and this was expected to increase the proportion of students from low-income homes in these institutions. In effect, however, no evidence was found of an increase in the proportion of university students from low-income families, although this does not weaken the contention regarding the existence of a liquidity constraint for university studies. There are two main reasons for this; first, because the effect of the reduction in tuition fees on low-income individuals who did not intend to study could be gradual and take place over considerable time, whereas we examined only those students who began studying shortly after the tuition fees were reduced. Second, because expectations of further reductions in tuition fees (as announced by the government) could have caused some students with a liquidity constraint to defer the start of their university studies.

Appendix 1

The Returns on a First Degree

An individual's returns to a first degree are defined as the current value added on income, assuming that he/she is studying for a first degree (adjusted for tuition fees) in comparison with the current value of his/her income if he/she is not studying for a first degree. Subject to several assumptions, it can be shown that the returns to a first degree are equal to the difference in percentage terms in income per unit of time (e.g., a month or a year) deriving from studies for a first degree. Most of the research on returns to education are based on this result, as data on individuals' income throughout their life time are not available. Thus, for example, Griliches (1977) Card (1995), Angrist and Krueger (1991), Card and Lemieux (2001) as well as others used data based on annual income in order to calculate the returns to education, where the contribution of a year of study to an increase in wages is cited as the returns to education.

The main assumption required for using the wage gap as the returns to education is that the wage differential between workers with or without a first degree does not change throughout their lifetime. To all intents and purposes, this assumption appears to be reasonable, but the wage data we have for 2004 and 2005 for persons aged 27 to 31 and over arouses the suspicion that it does not obtain, at least not in the initial period of employment.²²

The hypothesis that the wage differences between individuals with and without a university degree do not change after the age of 30 was tested by examining the returns on work seniority for two population groups of these ages. We calculated the returns to one year of seniority in two ways: 1) An examination of the average wage difference in a given

²² Taking military service in Israel into account, it would seem that the ages in the sample at our disposal are similar to those in the sample studied by Heckman and Li (2003) (average age, 26.3), who calculated the returns on education in China, but are younger than those studied by Card (1995) (persons aged 24-34), and Kane and Rose (1993) (individuals up to 6 to 14 years after graduating from high school).

year between similar groups which differ from one another in age; 2) A follow-up of the change in the wage of a fixed population between 2004 and 2005.

Appendix table 1 presents the wage differences in 2004 and 2005 between similar population groups which differ in age. As can be seen from the table, in 2004 the wages of men born in 1974-1976 (i.e., average age 29) who had not completed a first degree were 9 percent higher than that of individuals born in 1975-1977 with similar education. In the following year, too, the wage difference between the two groups was greater than 8 percent. Dividing the individuals into age-groups by year of birth shows that there are high returns to seniority for all age-groups; for the 28-29 age-group the returns to seniority are about 11 percent, and this declines to 7-9 percent for the 30-31 age-group. Among women with no degree in the 28-31 age-group the returns to seniority are the lowest – between 2 and 7 percent – because the seniority of women in the labor market is greater. It is reasonable to assume that part of the difference in the returns to seniority between men and women expresses the process of wage-stabilization after several years of seniority in the labor market. Another part may express a different wage profile for men and women. For individuals with a degree the returns to seniority are significantly greater in the 28-31 age-group for both men (14-18 percent) and women (about 10 percent).

Appendix Table 1
Returns on Seniority for Individuals With and Without a Degree aged 28-31 (%)*

		Men		Women	
		By wage in 2004	By wage in 2005	By wage in 2004	By wage in 2005
Wage of 1974-1976 cohort v. wage of 1975-1977 cohort	No degree**	9.3	8.3	5.5	4.4
Wage of 1974 cohort v. wage of 1975 cohort	No degree**	8.5	7.9	3.3	2.1
Wage of 1975 cohort v. wage of 1976 cohort	No degree**	9.1	6.9	6.9	7.1
Wage of 1976 cohort v. wage of 1977 cohort	No degree**	11.5	11.3	7.3	4.9
Wage of 1974-1976 cohort v. wage of 1975-1977 cohort	With degree***	17.6	14.0	10.8	9.5

* According to individuals who worked at least one month in the year in which we measured their wage, excluding individuals with income of over NIS 100,000.

** Did not complete degree by year in which we measured their wage.

*** 1974-1976 cohort who completed first degree by 2002, in relation to 1975-1977 cohort who completed first degree by 2003.

Another approach to identifying returns to seniority is by means of a follow-up of the change in wage of a fixed population between 2004 and 2005.^{23,24} Appendix Table 2 presents this approach. As can be seen from the table, the returns to one year of seniority among men without a degree aged 28 to 31 are between 6 and 8 percent. Among individuals with a degree the returns are higher – about 15 percent for men with average seniority of more than four years since completing their first degree. Women in the 28 to 31 age-group with average seniority of five years since completing their first degree have lower returns to seniority – about 4 percent for those without a degree and 8 percent for those with a first degree. These data are consistent to a great extent with the returns to one year's seniority calculated according to the method that compares the wage gap in a given year for population groups which differ by age.

Thus, as stated, we see a marked difference in the returns to seniority in the 28-31 age-group between individuals with and without a degree. Although it is reasonable to assume that part of the reason for this is the lower labor-force seniority of educated persons, and especially seniority since completing a degree, which is usually the relevant issue for an employee's seniority, the wage profile of educated persons over their lifetime may differ from that of uneducated persons, so that the returns to seniority for each year of seniority may vary. In this case, the assumption that the wage gap between individuals with and without a degree remains constant over time is not correct, and so we cannot assess the returns to education throughout the individual's lifetime. For that reason we have chosen to focus on the premium on a degree for individuals aged 30-31 without asserting that this constitutes returns to a degree.

²³ These data for the returns for one year of seniority could be biased upwards to some extent because they refer solely to active workers, assuming that there is selection which leaves highly paid employees in the market, while some of those earning a low wage are ejected from the market, thus creating bias in the calculation of returns to seniority. This problem obtains for almost every attempt to estimate returns to seniority, and does not appear to be significant.

²⁴ When we followed up the change in the wage of individuals between 2004 and 2005 we had to ensure that the change in wage between those two years stemmed from incremental seniority and was cleansed of macroeconomic influences which could have contributed to wage changes (inflation, lower unemployment, etc.). In order to achieve this, we examined the change in wages between 2004 and 2005 for similar 'quality' groups (as regards age and education). The examinations indicated that there was no significant change in wages from 2004 to 2005.

Appendix Table 2
Incremental Wage (%) per Year of Seniority in 2005, for Persons With and Without a Degree, 1974-1977 Cohort*

		Men	Women
Total sample		11.1	6.1
1974-77 cohort	No degree	7.0	4.0
1974 cohort	No degree	6.1	2.7
1975 cohort	No degree	6.0	4.2
1976 cohort	No degree	7.9	3.7
1977 cohort	No degree	8.2	5.5
Completed degree by 2003**	With degree	16.4	8.1
Completed degree by 2001***	With degree	15.1	7.7
Completed degree in 2002-3****	With degree	17.0	8.5

* Observations with monthly wage of over NIS 100,000 omitted.

** 1974-1976 cohort who completed first degree by 2003.

*** Men who completed first degree in 2000 on average -1, women who completed first degree in 2000 on average -0.

**** Men who completed first degree in 2002 on average -6, women who completed first degree in 2002 on average -5.

Appendix 2

Correlation Between Population Groups by Per Capita Income According to Father's Income in 1995 and 2005 (percent)

		Per capita income group by father's income in September 1995			
		1	2	3	4
Per capita income group by father's income in 2005	1	17	4	1	1
	2	4	16	5	1
	3	1	4	16	4
	4	1	1	5	19

The division into four population groups is for Jews born in 1974-1975 who attended a general high-school track.

REFERENCES

- Angrist, Joshua D. and Alan B. Krueger (1991). "Does Compulsory School Attendance Affect Schooling and Earnings", *Quarterly Journal of Economics* 106, 979-1014.
- Cameron, S. V. and J. J. Heckman (1998). "Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males", *Journal of Political Economy* 106 (2), 262-333.
- Card, David (1995). 'Using Geographic Variation in College Proximity to Estimate the Return to Schooling,' in: *Aspects of Labour Market Behaviour: Essays in Honour of John Vanderkamp*. L. Christofides, E. Grant and R. Swidinsky, eds. Toronto: U. Toronto Press, 201-222.
- Card, D. (2001). "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems", *Econometrica* 69 (5), 1127-1160.
- Card, D. and T. Lemieux (2001). "Education, Earnings, and the 'Canadian G.I. Bill'", *Canadian Journal of Economics* 34, 313-344.
- Carneiro, P. and J. Heckman (2002). "The Evidence on Credit Constraints in Post-Secondary Schooling", *Economic Journal* 112, 705-734.
- Carneiro, P. and J. Heckman (2003). "Human Capital Policy", in: Heckman, J. and A. Krueger (eds.), *Inequality in America: What Role for Human Capital Policies*, Cambridge: MIT Press.
- Ellwood, D. and T. Kane (2000). "Who is Getting a College Education: Family Background and the Growing Gaps in Enrollment", in: S. Danziger and J. Waldfogel (eds.), *Securing the Future*, New York: Russell Sage Foundation.
- Friedmann, Y. (2007). "Liquidity Constraints on the Attainment of Tertiary Education in Israel", Bank of Israel Research Department, Discussion Paper 07.2007.
- Frish, R. (2007). "The Causal Effect of Education on Earnings in Israel", Bank of Israel Research Department, Discussion Paper 03.2007.
- Griliches, Z. (1977). "Estimating the Returns to Schooling: Some Econometric Problems", *Econometrica* 45 (1), 1-22.
- Heckman, J. J. and X. Li (2003). "Selection Bias, Comparative Advantage and Heterogeneous Returns to Education: Evidence from China in 2000", *NBER Working Paper* 9877.
- Kane T. J. (1994). "College Entry by Blacks Since 1970: The Role of College Costs, Family Background, and the Returns to Education", *Journal of Political Economy*, 102(5), 878-911.
- Kane, T. J. (1996a). "College Costs, Borrowing Constraints and the Timing of College Entry", *Eastern Economic Journal* 22(2), 181-194.
- Kane, T. J. (1996b). "Lessons from the Largest School Voucher Program Ever: Two Decades of Experience with Pell Grants", in: Fuller, B., R. Elmore and G. Orfield, (eds.) *Who Chooses? Who Loses? Culture, Institutions and the Unequal Effects of School Choice*. New York: Teachers College Press.
- Kane, T. J. (2001). "College going and inequality: a literature review", *Working Paper*, Russell Sage Foundation.

- Kriaf, T. (2008). "The Free Compulsory Education Law in Israel, and Liquidity Constraints", Bank of Israel Research Department, Discussion Paper 06.2008.
- Leuven, E. and B. Sianesi (2003). PSMATCH2: Strata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing, Statistical Software Components S432001, Boston College Department of Economics.
- McPherson, M. S. and M. O. Schapiro (1991). "Does Student Aid Affect College Enrollment? New Evidence on a Persistent Controversy", *The American Economic Review* 81, 309-318.
- Rubinstein, Y. and D. Tsiddon (2004). "Coping With Technological Change: The Role of Ability in Making Inequality so Persistent", *Journal of Economic Growth* 9 (3), 305-346.
- Shochat Committee (2007). *Report of the Committee to Examine the System of Higher Education in Israel* (Hebrew).
- Vinograd Committee (2001). *Report of the Committee for the Gradual Reduction of Tuition Fees at Institutions of Higher Education, and the Examination of Possible Additional Concessions for Students* (Hebrew).