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**The Contribution of Vocational High School Studies to
Educational Achievement and Success in the Labor Market**

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Abstract

The study examines the contribution of vocational versus academic high school studies to educational achievement and success in the labor market. The research is based on the results of high-stakes examinations given to all Jewish students in Grade 8 in Israel, which were used to determine their high school track, and on information from the Population and Housing Census. A variety of statistical methods were used to overcome the problem of selection bias in the choice of educational track: selection on observables, propensity score matching and regression discontinuity.

The results of the study show that the educational achievement of vocational high school graduates was substantially lower than that of similar academic high school graduates. They attained less post-secondary education, entered less prestigious occupations and according to some of the results earned less. This was true even for individuals with low cognitive abilities who constitute the target population for vocational education. In contrast, the effect of a vocational high school education on employment rates was no different than that of an academic high school education and some of the findings indicate that it helped reduce high school drop-out rates, which was one of its main objectives.

JEL Classification: I20, I21, J24, J31

Keywords: vocational education, educational achievements, wage differential

תרומתו של חינוך תיכוני מקצועי לעומת עיוני להשכלה ולהצלחה בשוק העבודה

נעם זוסמן ושי צור

תקציר

המחקר בחן את התרומה של לימודים תיכוניים בנתיב מקצועי לעומת לימודים בנתיב עיוני לרכישת השכלה ולהצלחה בשוק העבודה. המחקר התבסס על תוצאות "מבחני הסקר" שנערכו לכל התלמידים בכיתה ח' (בחינוך העברי) בישראל בשלהי שנות השישים – מבחנים שבדקו בין השאר את כישוריהם הקוגניטיביים ושימשו למיון התלמידים בין נתיבים בתיכון. "מבחני הסקר" זווגו עם מפקדי האוכלוסין והדיוור של 1983 ו-1995. נעשה שימוש במיגוון שיטות סטטיסטיות – אמידה מרובת-משתנים (OLS), שבה שולבו מאפיינים אישיים רבים של התלמידים ומשפחתם, ציוניהם ב"מבחני הסקר" והעדפותיהם לגבי המשך הלימודים; propensity score matching; ואי-רציפות (regression discontinuity) בסיכויי הקבלה לחינוך העיוני כתלות בציוני התלמידים ב"מבחני הסקר". השימוש ב"מבחני הסקר" מאפשר להתגבר על בעיית הסלקציה בבחירת נתיב הלימודים, סוגיה שלא טופלה במידה מספקת בספרות המחקרית בנושא.

תוצאות המחקר מלמדות שהישגי התלמידים בוגרי החינוך המקצועי היו נמוכים בהרבה מאלו של בוגרי חינוך עיוני דומים להם: הם רכשו פחות השכלה על-תיכונית, היוקרה של משלחי ידם הייתה פחותה, ועל פי חלק מהתוצאות שכרם החודשי ושכרם לשעת עבודה היה נמוך יותר – אפילו בקרב בעלי כישורים קוגניטיביים נמוכים שהיוו אוכלוסיית יעד לחינוך המקצועי. לעומת זאת, לא הייתה לחינוך המקצועי השפעה שונה מזו של החינוך העיוני על שיעורי התעסוקה של הבוגרים, וחלק מהממצאים מלמדים שהוא סייע בצמצום הנשירה מהתיכון – אחד היעדים המרכזיים שלו.

1. Introduction

Vocational education is an important component of the Israeli education system and currently accounts for about one-third of all high school students. Vocational education and its curriculum have wide-ranging implications for the acquisition of human capital. This in turn affects labor productivity, and therefore the proportion of students in vocational education has an effect on economic growth and the distribution of income.

The scope of vocational education in Israel and its curriculum have for many years been a focus of attention among educators, economists and policymakers as a result of the ongoing decrease in the share of vocational education, the sharp cuts in expenditure per student and the shortage in technologically-skilled manpower. Those who advocate increasing the number of students in vocational education and strengthening vocational training claim that it increases the earning potential of low-ability individuals, who would have had difficulty succeeding in academic high schools, and relieves the shortage in technical manpower that constrains economic growth. On the other hand, opponents claim that vocational education leads to tracking, and with it labeling and stereotyping, and that it also lowers educational achievement. Neither does it supply the basic skills needed in a modern society, in view of the rapid pace of technological change and the increase in return on general human capital. And finally, it is inefficient due to its relatively high cost. The result is lower earning power for graduates of vocational high schools, slower economic growth and increased income disparity.

The present study focuses on the contribution of vocational vs. academic high school studies to certain outcome variables, i.e. educational achievement and success in the labor market.

The database for the research is based on the *Seker* examinations (a battery of tests given to all Jewish students in Grade 8 during the 1960s, whose results provide an indication of cognitive abilities; hereafter: the “examinations”),¹ family background questionnaires and the student’s preferences for high school education. The results of the high-stakes *Seker* examinations determined a student's high school track and served as the main criterion for high school tuition scholarships. The results of the exams were matched with the Population and Housing Census for 1983 and 1995, which provided information on the outcome variables for the individuals in their early 30s and/or 40s.

In order to overcome selection bias in the choice of educational track, various econometric methods were used: OLS (using a wide variety of explanatory variables that are correlated with the choice of track); propensity score matching; and regression discontinuity in the chances of acceptance to an academic high school as dependent on the students’ exam scores.

The results of all the estimation methods show that in the majority of cases the educational attainment and labor market success of vocational high school graduates were much lower than those of similar graduates of academic high schools. Thus, they

¹ The results of the examinations in the Arab education system and for other periods were not available.

acquired less post-secondary education, entered less prestigious occupations and in some cases earned lower hourly and monthly wages. These results were obtained even for individuals with low cognitive abilities who traditionally have been the target population of vocational education. In contrast, the effect of vocational education was no different than that of academic education on employment among graduates and some of the findings showed that it helped reduce high school drop-out rates, which is one of its main goals.

The article is organized as follows: Section 2 will review the literature. Section 3 will describe the database and provide some descriptive statistics and Section 4 will present the methodology. Section 5 will be devoted to the empirical findings and Section 6 will conclude.

2. Survey of the literature²

Supporters of vocational education present a number of arguments in their favor: vocational education reduces drop-out rates and raises the earning power of low-ability individuals who would have had difficulty succeeding in academic high school studies. On the macro level, they claim that it increases socioeconomic mobility and reduces inequality. In addition, its graduates provide manpower to the army and economic sectors that are in need of skilled workers.

The opponents of vocational education claim that it leads to the acquirement of specific human capital, which is subject to accelerated obsolescence in an era of rapid technological change. This is in contrast to the increase in the return to general human capital which facilitates mobility between sectors and thus increases growth (Galor and Tsiddon, 1997; Galor and Moav, 2000; Kruegar and Kumar, 2004).

The obsolescence of specific human capital involves a waste of resources and moreover the public expenditure per student in vocational high schools in Israel is higher by one half than that in academic high schools. In addition, there is an extended period of time from the completion of high school studies until entry into the labor market due to the long compulsory military service (three years for men and two years for women).

Finally, the opponents of vocational education claim that it usually involves tracking at a relatively early age – before the abilities of a student are fully revealed and his preferences fully formulated. This is in addition to the labeling of vocational education and a relatively low threshold of demands, which lead to lower achievement among the students and reduce the chance of attaining a higher education. Thus, they claim that vocational education works to maintain a low socioeconomic status and increases inequality of income.

² The survey is partly based on Zussman et al. (2005) and Tsur (forthcoming).

The central claim of the supporters of vocational education is, as mentioned, the reduction in drop-out rates from the education system. This is primarily due to the fact that vocational training empowers the student and provides him with the opportunity to learn according to his needs. The prevention of drop-outs naturally has positive implications, not only on the continuation of studies and integration in the labor market but also in the reduction of social costs, which are the result of negative behavior that is common among alienated youth. According to the literature, vocational education indeed reduces the drop-out rate from the education system (see, for example: Bishop, 1989; Shavit and Muller, 2000; Plank, 2001; Bishop and Mane, 2004, Silverberg, et al., 2004).

Shavit (1984) showed that the drop-out rates from vocational high schools in Israel among individuals with low cognitive abilities were lower than in academic high schools and that the opposite was true among those with high cognitive abilities. The rate of matriculation in vocational education was much lower than in academic education.

Zussman et al. (2005) found that matriculation scores among vocational high school students in Israel during the late 1990s were lower than those of similar students (with respect to ability and background characteristics) in academic high schools. This is particularly true among low-ability students. According to studies in various countries, vocational education reduces the probability of acquiring a higher education (for a summary of the findings in the US, see Silverberg et al., 2004).

Successful integration in the labor market can serve as a measure for evaluating the benefit from vocational education relative to academic education. A number of studies in Israel, most of which related to the 1980s, showed that a relatively high proportion of vocational high school graduates (between one-third and one-half) were working in the field they had studied in high school. The return in terms of the earnings of vocational high school graduates who did not continue on to post-secondary education and were working in the field they had studied in high school was higher than that of academic high school graduates who had similar family backgrounds. On the other hand, working in a field other than the one studied in high school did not lead to a higher return in terms of earnings (Zorman and Hayam-Yonas, 1998; Neuman and Ziderman, 1991 and 1999).

Gabai (2003) did not find any differences in occupational prestige and in level of income between graduates of vocational high schools and those of academic high schools who did not continue on to post-secondary education; however, the former had a lower rate of unemployment. Among those who continued their studies, the overall effect of vocational education in comparison to that of academic education on success in the labor market was in most cases negative, i.e. occupational prestige and level of income were lower (although only among women) and the probability of being unemployed was higher for women but lower for men. Shavit (1992) showed that occupational prestige among graduates of vocational high schools was lower than among graduates of academic high schools.

Tzur (forthcoming) found that increasing the scope of academic studies as part of the reform of vocational education in Israel in the early 1990s significantly increased the proportion of students in vocational education who wrote the matriculation exams and the proportion that attained a matriculation certificate. It also increased the accessibility of higher education for them and according to partial findings also positively affected earnings. Furthermore, students in vocational education who had difficulty in achieving a matriculation certificate benefited from the reform, which improved their position in the labor market.

It should be emphasized that due to data limitations, cognitive abilities were not controlled for in most of the studies done in Israel on the effect of educational track on success in the labor market. Furthermore, the comparison of the returns on education was in some cases carried out among graduates of the two tracks who did not continue on to post-secondary education. For these reasons, the estimates of the return on vocational education may be biased. Students who chose vocational education were in general characterized by relatively low ability; therefore, it is likely that the estimates of the return on vocational education are biased downward. On the other hand, many of the graduates of academic high schools who did not continue on to higher education probably had relatively low abilities since a large proportion of graduates of academic high schools do in fact continue on to higher education. Thus, some of the studies overestimated the return on vocational education.

Studies in other countries, which did *not* take into account the problem of selection bias (and in most cases did not control for cognitive abilities either) found that although in some cases vocational high school education did in fact reduce the probability of attaining a higher education and entering a more prestigious occupation, in certain circumstances it contributed to success in the labor market more than academic education did (although usually the comparison was made with graduates of academic high schools who did not continue their studies). Thus, it raised participation rates, reduced unemployment and employment in unskilled jobs, improved earnings, etc. Cost-benefit analyses of the additional expenditure on vocational training as compared to the increase in lifetime earnings concluded in general that the investment was worthwhile. (See, Kang and Bishop (1989), Shavit and Muller (2000), Arriagada and Ziderman (1992), Arum and Shavit (1995), Bennell (1996), Brauns et al., (1997), Horowitz and Schenzler (1999), Mane (1999), Griffith and Wade (2001), Sakellariou (2003) Bishop and Mane (2004), Silverberg et al. (2004), Newhouse (2004) and Suryadarma (2009).)

The advantage of graduates of vocational high schools in the labor market over graduates of academic high schools was identified primarily in the following cases: in developing countries, which are characterized by rapid growth and experience a shortage of skilled manpower; in cases where vocational education provides a practical profession and the curriculum and training are determined in close cooperation with employers and even with their participation (such as the mentoring programs in Germany); and when graduates of vocational high schools are assimilated into an

occupation that is related to their field of study in high school, particularly when those studies are technologically-oriented and when the graduates are women.

Studies that took into account selection bias, among other things, more often showed a positive contribution of vocational education to success in the labor market and that it was larger than the contribution of academic education, both among those who immediately entered the labor market and among those who continued on to post-secondary education (Lopez-Aveco, 2003; Moenjak and Worswick, 2003; Cappellari, 2004; Meer, 2007; Pema and Mehay, 2009). In contrast, other studies showed that vocational education does not contribute to success in the labor market more than academic education and that it reduces the chances of continuing on to higher education (for example, Chen, 2009).

Finally, a number of studies have used changes in the age at which tracking is done and/or the age of compulsory education – which affect the number of years spent in each track – in order to examine the contribution of vocational education to educational achievement and success in the labor market. The use of this quasi-natural experiment solves the problem of selection bias in the choice of high school track. Oosterbeek and Webbink (2006) found that in Holland the return on an additional year of vocational education is no higher than that of an additional year of work experience. Pekkainen et al. (2006) showed that in Finland an increase in the age at which tracking is done weakened the effect of family background factors on the acquisition of a higher education and therefore led to a weakening of the intergenerational correlation in income. Dustmann (2004) showed that early tracking in Germany increased inequality in earnings (and in test scores). Malamud and Pop-Eleches (2008a, 2008b) found that tracking at a later age in Romania reduced, as expected, the proportion of those in manual occupations but did not change the probability of being employed or earnings, nor did it increase the chances of a student from a weak background attaining an academic degree.

3. The database and descriptive statistics

The *Seker* examinations, which during the period of 1955-73 were written by all Grade 8 students in Israel, included a wide variety of questions in mathematics, Hebrew and English, as well as questions that reflect cognitive ability (such as, generalizations and antonyms). The examinations were accompanied by a comprehensive questionnaire on the student's family background (parents' level of education, number of siblings, etc.) and his desires for continuing his studies (including which track he preferred).

Only students who passed the exams could continue their studies in an academic high school since for many schools this was a criterion for acceptance. The rest of the students who wished to continue their studies were forced to attend vocational or agricultural schools, which were much less prestigious. The exam scores also became a criterion for receiving a tuition scholarship for an academic high school. Thus, the

Seker examinations constituted a high-stake test with respect to a student's future in the education system and in the labor market.

Our database included the results of the *Seker* examinations and the responses on the accompanying questionnaire for students in the Hebrew education system (almost all of whom are Jewish) during the 1966/67 and 1967/68 school years. The data was matched with the files of the expanded questionnaires of the Population and Housing Census for 1983 and 1995, which included information on the students' socioeconomic characteristics once they had reached their early 30s and/or 40s.

A total of 49,516 students wrote the *Seker* examinations in the 1966/67 school year and 44,426 in the 1967/68 school year. The rate of participation in the exams was 96.9 percent. Ultra-Orthodox students, students in special education and students who were absent on the day of the exams did not participate.

Of the students who wrote the exams, 21,296 answered the expanded census questionnaire (which were given to a random sample of 20 percent of all respondents) – 11,200 in the 1983 census, 12,145 in the 1995 census and 2,049 in both. The overall rate of matching (22.7 percent) was lower than the expected rate (36 percent)³ because either the ID numbers were incorrect, the individuals had passed away prior to the census or the individual was not present in Israel at the time of the census.

Descriptive Statistics⁴

One-half of the students who wrote the *Seker* examination in 1967-8 and continued their studies attended vocational high schools (Table 1). The students in vocational high schools had a higher proportion of boys, tended to be of Asian-African descent, had a larger number of siblings and had less-educated parents than students in academic high schools. The students in vocational high schools scored lower on the exams (64.7 vs. 76.1) and their scores were for the most part located in the lower part of the score distribution, as can be seen in Figure 1. As a result, only a small proportion of those entering a vocational high school were eligible in the first place for a tuition scholarship in an academic high school. In addition, the proportion of students interested in a vocational education among those who actually went to a vocational high school was higher than in academic education.

With regard to the outcome variables, the level of education among graduates of vocational high schools was much lower than among graduates of academic high schools and similarly for rate of employment, monthly and hourly earnings and occupational prestige.

³ The probability of receiving the expanded questionnaire in the census was 20 percent and therefore we obtain 40 percent for the two censuses minus 4 percent for those who appeared in both censuses.

⁴ No differences were found in the demographic and socioeconomic characteristics of the tested students between 1967 and 1968 and therefore the descriptive statistics are presented for those two years combined.

Table 1
Descriptive Statistics¹

		Academic education	Vocational education		
Number of students (distribution, %)		4,446 (49.2)	4,587 (50.8)		
Males (%)		38.8	57.2		
Distribution by student's origin (%)	Israel	80.9	72.4		
	Asia-Africa	10.7	20.2		
	Europe-America	8.4	7.4		
Distribution by mother's origin (Israeli-born children, %)	Israel	20.0	13.2		
	Asia-Africa	32.5	56.1		
	Europe-America	47.6	30.7		
Number of siblings (including student)		2.5	3.0		
Mother's education (%)	Secondary school or higher	91.2	83.7		
	Post-secondary education or higher	32.0	25.5		
Father's education (%)	Secondary school or higher	54.0	34.4		
	Post-secondary education or higher	12.7	4.3		
Score on examinations		76.1	64.7		
Eligibility for high school tuition scholarship (%)		63.9	28.0		
Preference for vocational high school (%)		7.8	27.2		
Outcome variables (at 1995 census)					
		men	women	men	women
Education (%)	High school or higher	92.0	92.5	83.8	80.7
	Matriculation certificate or higher	77.3	76.8	42.1	32.1
	First degree or higher	43.7	31.7	11.6	4.5
Employed (%)		93.9	83.9	92.3	72.9
Wage (NIS, in 1995 prices ²)	Monthly wage	9,780	4,740	7,260	3,608
	Hourly wage	51.4	38.1	38.7	29.6
Occupational status	High ³ (%)	54.0	52.2	29.8	22.2
	Semyonov et al. (2000) scale ⁴	61.5	55.8	45.6	41.5

1) Students who answered the expanded questionnaire of the 1995 Population and Housing Census.

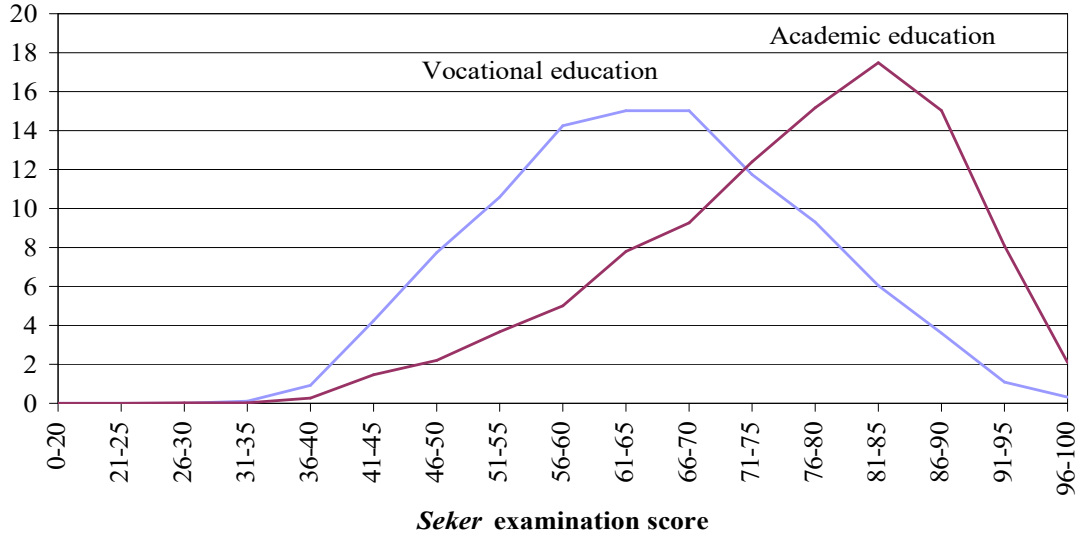
The percentages may not add up to 100 due to rounding.

2) In 1995, the NIS/\$ exchange rate was 3.01.

3) Academic professionals, associate professionals and managers.

4) A scale of 1 to 100, where 100 is the most prestigious occupation (see Section 5).

Figure 1
Distribution of *Seker* Examination Scores by Student's Track
 (percent)



4. Methodology

There are a number of methods for solving the problem of selection bias in the choice of educational track and we will make use of three of them: selection on observables, propensity score matching and regression discontinuity.

The selection on observables method (Rubin, 1973) assumes that the choice of educational track is explained by known and observable factors (parents' level of education, exam scores, student's preferred track, etc.). Apart from the effect of observable factors, the choice is dependent on random unobservable or non-measurable factors that offset one another on average. Nonetheless, even if a large variety of control variables is included in the OLS estimation, there is no guarantee that the estimates will be unbiased.

The first stage of propensity score matching (PSM; Rosenbaum and Rubin, 1983) involves estimating the probability of being in the treatment group (i.e. in vocational education, $[T_i=1]$) for student i with the characteristics $X_i - P_i \equiv \Pr(T_i = 1|X_i)$, using a probit or logit binary choice model. Following that, each observation in the treatment group is matched with an observation (or several observations) in the control group (academic education) that are close to it, according to the expected probability \hat{P}_i , which is called the propensity score. Finally, the PSM conditional effect of treatment is calculated as an average of the treatment effects Y for all observations from the treatment group and the specific control groups that were matched with them:

$$(1) \hat{\Psi} |_{T=1, P(X)} = \frac{1}{N} \sum_{i \in N} \left(Y_i - \frac{1}{J} \sum_{j \in J} Y_j \right)$$

where N is the number of observations in the treatment group for which a match was found according to PSM and J is the number of control observations per observation i of the treatment group.

Several studies have made use of the PSM method for similar purposes, such as Mocan and Tekin (2002), Chevalier and Conlon (2003) and Black and Smith (2004).

The method used to match the observations in the treatment group with those in the control group is important (Heckman et al., 1998; Dehejia and Wahba, 2002). When the common support, i.e. the range of predicted probabilities in which there is a non-negligible frequency of students in both vocational and academic education, is sufficiently broad, then in general the various methods of matching produce similar results. We decided that it would suffice to use one method of matching: group matching of all observations that fall within a caliper whose width is 0.0001 of the predicted probability without re-sampling (for further details, see Section 5 Part b). Other methods of matching led to similar results.

As part of the regression discontinuity design method (Thistlewaite and Campbell, 1960), use is made of the fact that whether a student is studying in an academic high school is to a large extent determined by whether he has received a certain score or higher (70 for example) on the exam. Therefore, the probability of a student who exceeded the threshold, even by a small amount, to attend an academic high school are much higher than those of a student who received a score that is lower, even by a fraction. Although students whose scores are above the threshold by a small amount have on average higher abilities than those whose scores were somewhat below the threshold, the difference between them is negligible and to some extent random and uncorrelated with the outcome variables. Therefore, the estimates derived from them are unbiased.

More precisely, use was made of the two-stage least squares (TSLS) method for a sub-group of students whose scores on the exams were within the vicinity of the threshold score (70 in the case below). In the first stage (Equation 2), the probability of student i attending a vocational high school is estimated as being dependent on a dummy variable *Grade_over70* which receives a value of 1 if the student received a score exceeding the threshold and 0 otherwise, and an array of variables X that control for the student's family background and his preferences for an educational track in high school. In the second stage (Equation 3), the outcome variables Y are estimated using the predicted value of the vocational education variable from the first-stage equation, \hat{MIK}_i , while controlling for the student's background variables.

$$(2) MIK_i = \lambda + \theta_1 [Grade_over70] + \theta_2 X_i + \varepsilon_i$$

$$(3) Y_i = \eta + \delta_1 \hat{MIK}_i + \delta_2 X_i + u_i$$

The regression discontinuity method is commonly used in the literature and has recently been applied in a similar framework by del Bono and Clark (2008). They examined how acceptance to a prestigious school on the basis of exceeding a threshold score affected the success of the graduates over their lifetime.

5. Estimation results

We estimate the effect of vocational as opposed to academic high school studies on outcome variables that are related to educational achievement (probability of completing high school, eligibility for a matriculation certificate and attainment of a first degree or higher) and success in the labor market (employment, monthly and hourly wages and occupational status).

Occupational status was defined in two ways: a. the classification of occupations into high-prestige (academic professions, professionals and managers) and low-prestige categories; b. reliance on the Semyonov et al. (2000) scale of 0 to 100 according to level of education and wage based on the 1995 Population and Housing Census.

The estimation was, as mentioned, carried out using three statistical methods: OLS, PSM and regression discontinuity and the results are presented in that order. The outcome variables were taken primarily from the 1995 census when high school graduates were in their early 40s since only for that census was it possible to identify the educational track of all the graduates. Nonetheless, the outcome variables for the 1983 census are also discussed.

a. OLS

Table 2 presents the results of OLS estimation, in which the following background characteristics were controlled for: gender, whether the student is an immigrant, parents' education and continent of origin, the student's number of siblings, year of the exam (cohort) and fixed effect of the place of residence.⁵

All the outcome variables pointed to a large disparity in favor of academic over vocational education. When the student's exam score is added as an explanatory variable, which, as mentioned, reflects his cognitive abilities, the gap is reduced in size but still remains large and statistically significant and the equation's explanatory power improves. Thus, previous estimates in other studies of the effect of vocational education, which did not take into account differences in students' cognitive abilities, are biased downward (i.e. they are too small in absolute terms).

⁵ The fixed effect of place of residence essentially reflects the accessibility of academic high schools in the location, the quality of the education system and socioeconomic characteristics that are common to the residents and unobservable to the researchers. In all the cities and regions in Israel there is a significant proportion of students in both vocational and academic education. In other words, there are few students living in an area without academic high schools (including comprehensive schools which had academic specializations).

The estimation results indicate that students in vocational education lag behind those in academic education in the following outcomes: completion of high school (by about 3 percentage points),⁶ attaining a matriculation certificate (by 22 percentage points; not shown), attaining a first degree or higher (by about 15 percentage points) and entering a high-status occupation (by about 12 percentage points). (The difference on the occupational status scale is about 6 points, which is equivalent to about 10 percent – not shown.) Finally, the monthly wage of graduates of vocational high schools is lower by about 10 percent and similarly for the case of the hourly wage.

Table 2
The Effect of Vocational versus Academic High-School Education on
Educational Attainments and Labor Market Success
OLS

	Vocational education	Exam score	Number of observations	Adjusted R ²
High-school completion	-0.076*** [0.007]		8,917	0.11
	-0.029*** [0.007]	0.005*** [0.000]	8,899	0.14
Academic degree	-0.251*** [0.012]		8,917	0.25
	-0.146*** [0.011]	0.012*** [0.001]	8,899	0.34
Employment	-0.051*** [0.007]		8,917	0.12
	-0.024*** [0.007]	0.003*** [0.000]	8,899	0.12
High-status occupation¹	-0.223*** [0.013]		7,745	0.18
	-0.116*** [0.014]	0.012*** [0.001]	7,727	0.24
Monthly wage	-0.228*** [0.019]		6,618	0.30
	-0.100*** [0.019]	0.014*** [0.001]	6,601	0.33
Hourly wage	-0.227*** [0.021]		6,241	0.17
	-0.095*** [0.022]	0.014*** [0.001]	6,225	0.21

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.

1) High-status occupations: Academic professionals, associate professionals and managers.

⁶ Completion of high school is defined according to the response to a question regarding the highest degree attained. (The answer to that question was also used to define attainment of a first degree or higher.) If the completion of high school had been defined according to the response to the question on number of years of schooling, i.e. 12 years or more of schooling, then the chances of a vocational high school graduate of completing high school would be about 10 percentage points lower than an academic high school graduate.

Since some of the graduates of the education system did not enter the labor market, especially women and in particular women who attended vocational high schools, the wage equations are liable to be subject to selection bias. Therefore, wage equations that are adjusted for selectivity, using the Heckman (1979) correction, were also estimated. In this case, the estimation for the probability of being employed also included number of children and family income not earned by the woman. It appears that the estimated coefficients of vocational education in the adjusted wage equations are quite similar to those obtained in the regular wage equations.

There is a relatively high proportion of males in vocational education due to their tendency to learn technical – and recently hi-tech – professions. Therefore, separate estimations were done for men and women (Table A1 in the Appendix), which showed that for most of the outcome variables the gap is larger for women. In the case of men, there is in fact no difference between the tracks with respect to employment and completing high school.⁷ It is worth stressing the last finding since the high school drop-out rate among males is relatively high and one of the main goals of vocational education, particularly in the past, is to reduce those rates.

Traditionally, and particularly during the 1990s, vocational education has provided a solution for students with relatively low academic abilities, of whom only a small percentage are expected to continue on to higher education. Table A2 in the Appendix presents estimates of the effect of vocational education on students with a low exam score and also on students who did not continue on to higher education.

The educational achievement and success in the labor market of students with an exam score of less than 60 (about one-quarter of the students), who are graduates of vocational high schools, are much lower than those of similar graduates of academic high schools and in general the gaps are no different than those for all students.⁸

Measures of success in the labor market for high school graduates who did not attain an academic degree (about four-fifths of the students) were lower for vocational education graduates although the negative effect on wages was more moderate than for all students. It is worth emphasizing that the gaps in the outcome variables are biased downwards since an overwhelming proportion of those who attained an academic degree – the majority of whom successfully integrated in the labor market – are graduates of academic high schools.

In a questionnaire given prior to the exam, the students were asked, among other things, to indicate what they intend to study – if they wished to continue their studies – after completing elementary school (which at that time went up to Grade 8, when the exam was given) while distinguishing between vocational and academic education. It is important to focus on students who planned to attend an academic high school and to

⁷ Nonetheless, the probability of completing high school, which is defined according to 12 years of schooling or more, for male graduates of vocational high schools, is lower by about 8 percentage points than for graduates of academic high schools and the estimate is significant..

⁸ Similar results were obtained for students with a score of less than 55 (about one-seventh of the students).

compare the outcome variables between those who actually attended one and those who were forced to choose a vocational high school. In this way, differences in the outcome variables that probably were a result of a variation in preferences are neutralized, at least partially. It was found that gaps in the outcome variables are similar to those for all students in the two tracks.

The analysis has so far looked at the differences in outcome variables between graduates of vocational and academic high schools based on the responses to the expanded questionnaire of the 1995 Population and Housing Census. It would have been desirable to carry out a similar analysis for the 1983 census data since at that point the graduates were in their early 30s and had only a few years of work experience. Unfortunately, using the 1983 census data it is only possible to identify the educational track for those who did not continue on to post-secondary education, most of whom have low cognitive abilities. Therefore, the educational track of those who answered the expanded questionnaire in the 1983 census was determined according to the track indicated in the 1995 census, thus creating a representative sample of high school graduates. In general, the negative effect of vocational as compared to academic education on educational achievement and success in the labor market is similar to that found previously (Table A3 in the Appendix) though only in some cases were the estimated coefficients significant, apparently due to the small number of observations.

The results of the estimation using only the 1983 Population and Housing Census are presented in Table A4 in the Appendix. This involves, as mentioned, a comparison between graduates of vocational and academic high schools who did not continue on to post-secondary education, which is a common comparison made in the literature. In general, the differences in the outcome variables according to track were not significant, which was expected in view of the sizable proportion of graduates of academic high schools – who are apparently those with the highest abilities – that continued on to post-secondary education. An exception was a gap of 9 percent in wages in favor of male graduates of vocational high schools.

The 1983 census data can be used to determine the field of study in vocational education (for example, electricity, sewing and fashion) for those who did not continue on to higher education. The estimation results (not shown) indicate that the monthly and hourly wages of graduates of vocational high schools with specialization in electronics was higher at the time of the census by 14-15 percent than those of similar graduates of academic high schools and a higher proportion of them worked in a high-status occupation. The findings are not surprising since this group represents the top of the pyramid in vocational education at that time and they were studying a profession with a high demand in the labor market. In contrast, graduates of the other specializations had similar wages to graduates of academic high schools; nonetheless, a lower proportion of this group was in high-status occupations, a result that is statistically significant.

Based on the specialization in high school, a comparison was made between graduates of vocational high schools who did not continue on to post-secondary education and were or were not working in their field at the time of the census and graduates of academic high schools who did not continue their studies. Whether an individual was working in his field was determined according to his occupation, as in the approach of Neuman and Ziderman (1991).⁹ About 26 percent of graduates of vocational high schools were working in the occupation they had learned in high school.¹⁰ The OLS estimations, which were in a similar format to that presented in Table 2, show that the monthly and hourly wages of graduates of vocational high schools who were working in the occupation they had studied in high school was 8-9 percent higher than for similar graduates of academic high schools. There were no wage differences between graduates of vocational high schools who were not working in the occupation they had studied in high school and graduates of academic high schools who did not continue on to post-secondary education.

We now turn to an analysis of the increase in real wages between the 1983 and 1985 Population and Housing Census, according to educational track in high school.¹¹ The individuals included are those whose educational track was determined from the 1995 census and therefore this is a representative sample of the graduates of both tracks. The average monthly wage of graduates of academic high schools rose by an average of 8.1 percent annually while that of graduates of vocational high schools rose by 6.6 percent. Hourly wages rose by average annual rates of 7.2 percent and 6.2 percent, respectively. Although real wages grew rapidly, it should be remembered that these workers were in their 30s – a period during which the return on work experience is generally high and workers tend to switch jobs relatively frequently in order to upgrade their wages.

Table 3 shows that the monthly wage of graduates of vocational high schools rose by about 32 percent (about 2.4 percent per year) less than that of graduates of academic high schools, *ceteris paribus*, although the difference is not statistically significant. Similar results were obtained for hourly wages.

⁹ The list of occupations that are related to the various specializations in vocational education is available from the authors.

¹⁰ Neuman and Ziderman (1991) found that about 37 percent were working in the occupation they had studied in high school. The difference is due to their broader definition of occupations that are related to the field of study in high school.

¹¹ 55 percent of the graduates of academic high schools and 44 percent of the graduates of vocational high schools were employed at the time of both censuses.

Table 3
The Effect of Vocational versus Academic High-School Education on
the increase in Real Wages Between 1983 and 1995
OLS
(percent)

	Vocational education	Exam score	Number of observations	Adjusted R²
Monthly wage	-37.383* [22.751]		796	0.02
	-32.294 [22.751]	0.652 [0.891]	796	0.02
Hourly wage	-37.318 [34.125]		707	0.02
	-40.311 [35.969]	-0.383 [1.445]	707	0.02

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.

Some of the graduates of academic high schools who continued on to higher education were studying at the time of the 1983 census (when they were aged 29-30) and therefore it is possible that they were earning a low wage as a result. Since a higher proportion of graduates of academic high schools continued on to higher education, it is possible that the increase in their wages relative to those of graduates of vocational high schools is biased upward. In order to overcome this bias, the observations for high school graduates who were studying at the time of the 1983 census (about 8 percent of the graduates) were omitted from the estimation of the wage growth equation. However, the results remained unchanged (not shown).

Only in the case of those who learned clerical skills did the wages of graduates of vocational high schools rise at a faster rate than those of similar graduates of academic high schools. In contrast, in the rest of the specializations, the rate of increase in wages for graduates of vocational high schools was slower, though the difference was not statistically significant. These findings can be explained by the fact that there was no rapid technological change in the clerical occupations while the graduates in most of the other fields had to deal with such change and it is possible that many of them did not manage to adjust the specific human capital that they had acquired in high school to the changing work environment.

Finally, the return on each year of study in a vocational high school was tested (for students who did not continue on to post-secondary education), which is different from the comparison made up until now of the return on studying in a vocational relative to an academic high school. The estimation results for the hourly and monthly wage equations based on the 1983 census indicate that the return on a year of study in a vocational high school is between 4 and 5 percent while the results based on the 1995 census indicate a lower return – between 3 and 4 percent. This is apparently due to the increasing importance over the years of accumulated work experience relative to formal education acquired in the past.

b. Propensity Score Matching

The first stage in implementing the PSM method involves estimating the probability of treatment, i.e. attending a vocational high school. The estimation of Model 1 in Table 4 does not include the exam score and the tuition scholarship for academic high schools, while Model 2 does include these two variables. Explanatory power is much higher for Model 2 and therefore the probability of attending a vocational high school was based on it.

Table 4
Probability of Attending a Vocational Education, Logit

	Model 1	Model 2
Intercept	0.33*** [0.07]	2.61*** [0.15]
Seker score		-0.03*** [0.002]
Tuition scholarship for academic high-school		-0.29*** [0.047]
Preference for vocational education	0.74*** [0.040]	0.51*** [0.041]
1968 <i>Seker</i> examination	-0.18*** [0.046]	-0.07 [0.048]
Father with post-secondary education	-0.28*** [0.032]	-0.15*** [0.034]
Mother with post-secondary education	-0.217*** [0.05]	-0.145*** [0.05]
Father attended a vocational education	0.244*** [0.06]	0.155*** [0.06]
Pupil of European-American origin	0.22** [0.06]	0.12** [0.06]
Pupil of Asian-African origin	0.11*** [0.044]	0.02 [0.046]
Mother of European-American origin	-0.09* [0.051]	-0.09* [0.053]
Mother of Asian-African origin	0.377*** [0.052]	0.153*** [0.056]
Number of siblings	0.005 [0.009]	-0.019** [0.009]
New immigrant	-0.028 [0.091]	-0.155 [0.097]
Female pupil	-0.45*** [0.03]	-0.52*** [0.03]
Number of observations	8,899	8,899
Adjusted R²	0.119	0.197

Standard errors, clustered by student's area of residence, are reported in parentheses.

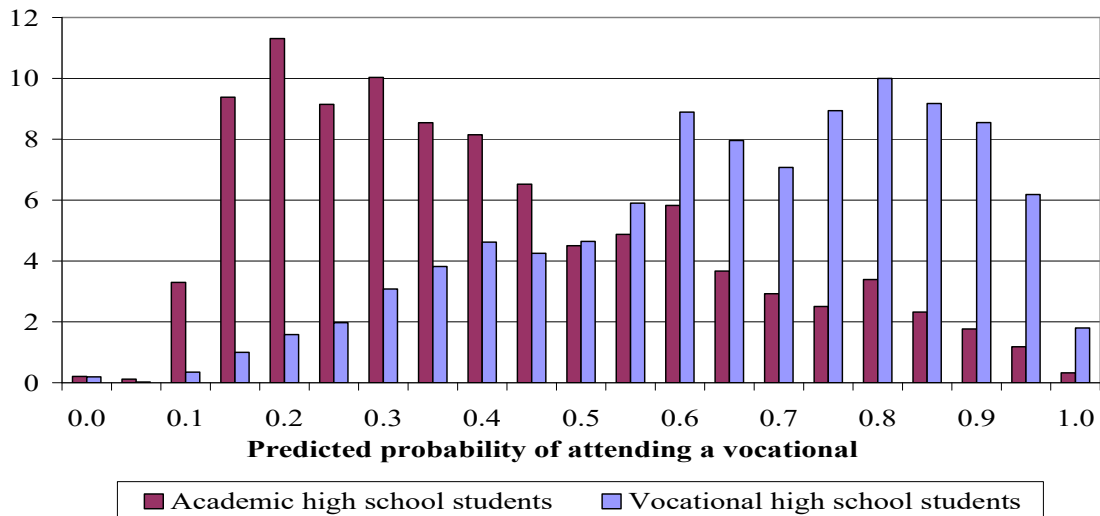
* Significant at 10 percent level; ** Significant at 5 percent level; *** Significant at 1 percent level.

Each point on the exam reduces the probability of studying in a vocational high school by 3 percentage points and of receiving a high school tuition scholarship by 29 percentage points. In contrast, the desire of a student to attend a vocational high school increases his probability of actually attending one by 51 percentage points. The following socio-demographic characteristics increase the probability of attending a

vocational high school: parents with a low level of education; a father who attended a vocational high school; a student of European-American descent; a mother born in Asia-Africa, fewer siblings and a male student.¹² These findings are in general consistent with those of Zussman et al. (2005) for Israel using more recent data and those of studies in other countries, which indicate that students from a weak socioeconomic background have a higher probability of attending a vocational high school (for example, Figlio and Page, 2002; Tunali, 2003; Silverberg et al., 2004; Agodini et al., 2004; Chen, 2009).

Figure 2 presents the distribution of students who wrote the exam according to the predicted probability of attending a vocational high school, as calculated from the estimation results presented in Table 2. There is a common support in which a large number of students can be identified who chose an academic high school, though with a relatively high probability they could also have chosen a vocational high school. They will be included in the control group.

Figure 2
Distribution of Tested Students by Predicted Probability of
Attending a Vocational Education
 (percent)



¹² Other estimated equations included additional explanatory variables relating to the area of residence, but their coefficients were not significant. These included: 1. rate of employment in occupations that require technical skills, which is an indirect measure of the demand for graduates of vocational high schools; 2. the average income of a salaried worker; 3. the average score on the *Seker* examinations, which may be positively correlated with the threshold for acceptance to academic high schools. Data for the first two variables was taken from the 1972 Population and Housing Census.

In accordance with the method described in Section 4, a group matching was carried out using a caliper of width 0.0001 or 0.001 of the predicted probability. It was found that a caliper of width 0.0001 was to be preferred since the similarity in characteristics between the treatment and control groups was much higher and at the same time the reduction in the number of observations only decreased the significance of the estimates somewhat. Figure 3 presents the number of observations that were matched: 1,311 in the treatment group and 1,287 in the control group. This constitutes about one-third of the students who were tested and continued on to high school.

Figure 3
Number of Matched Observations Using a Caliper Width of 0.0001,
by Predicted Probability of Attending a Vocational Education

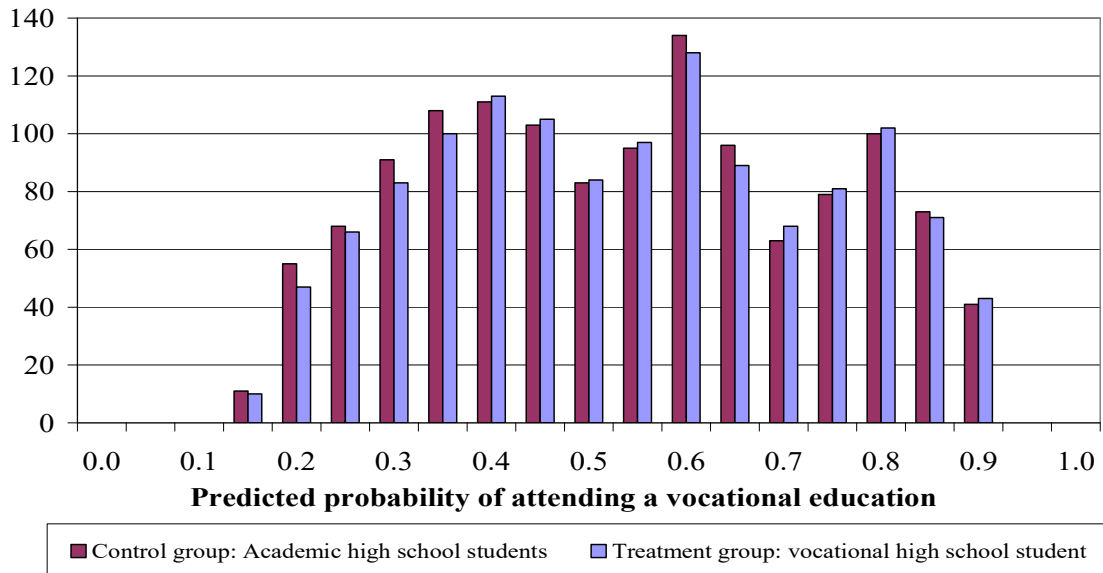


Table 5 compares selected background characteristics of students in the treatment and control groups. Among all the students included in the estimation of the predicted probability of attending a vocational high school there exists significant differences between the characteristics of students in vocational as opposed to academic high schools. The former can be characterized as follows: a lower average exam score; a much higher proportion that preferred to attend a vocational high school; a disproportionate number of mothers of Asian-African descent; fathers with a low level of education; and a lower proportion of female students, as seen in the descriptive statistics presented in Table 1. In contrast, the differences in characteristics between the two tracks among students who were matched using a caliper of width 0.0001 disappear almost completely.

Table 5
Characteristics of Students by Track: All Students¹ and PSM pairs

	All students		PSM (0.0001 caliper width)	
	Academic education	Vocational education	Academic education (control)	Vocational education (treatment)
<i>Seker</i> exam score	76.2	64.8	69.4	69.8
Prefers vocational education (%)	8	27	11	12
Mother from Asia-Africa (%)	37	60	50	51
Father with post-secondary education (%)	56	37	40	39
Girls (%)	62	43	54	55

1) Those included in the estimation of the probability of attending a vocational education.

According to the PSM estimation (Table 6), the differences in outcome variables between graduates of the two educational tracks are very similar to those obtained by the OLS method.. An exception is the estimated negative effect of vocational education on the probability of being employed, which was statistically significant using the OLS method but not in the PSM method.

The estimation was repeated separately for each gender and produced the following findings (not shown): the estimates for males were very similar to those in Table 6; in contrast, no differences were found for females between graduates of vocational and academic high schools in the probability of completing high school and in monthly and hourly wages.

The differences in the outcome variables among students whose scores were lower than the median (i.e. a score of 70) were also examined.¹³ Table A5 in the Appendix shows that the differences were similar to those found for all students. Nonetheless, the results should be treated with caution since the equation for the probability of attending a vocational high school has relatively low explanatory power (only about 7 percent).

¹³ The matching was done using a caliper of 0.001 instead of 0.0001 in order to obtain a reasonable number of observations (809 in the treatment group and 926 in the control group).

Table 6
The Effect of Vocational versus Academic Education on
Educational Achievements and Labor Market Success
PSM

High school completion	-0.04** [0.012]
Academic degree	-0.12*** [0.013]
Employment	-0.004 [0.008]
High-status occupation¹	-0.11*** [0.02]
Monthly wage	-0.08** [0.04]
Hourly wage	-0.09** [0.03]

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

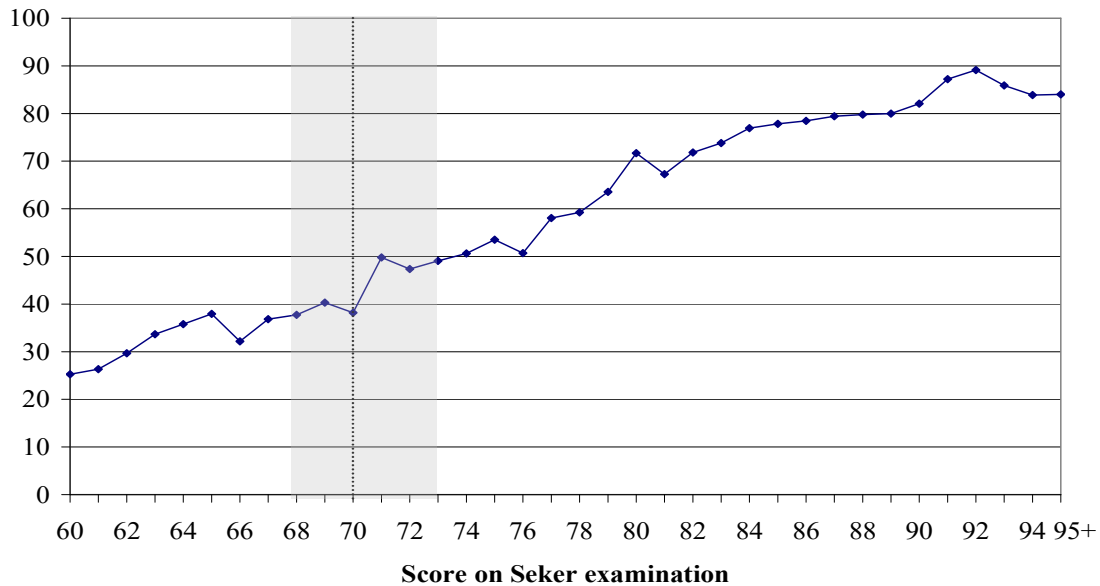
1) High-status occupations: Academic professionals, associate professionals and managers.

c. Regression discontinuity

The regression discontinuity method is based on discontinuity in the effect of a student's *Seker* examination score on his probability of obtaining vocational high school education. A point that meets this criterion is the transition from a score of 70 to a score of 71. Although this is not an unambiguous threshold score beyond which students were eligible to attend an academic high school, a score above 70 was generally viewed in this way and served as a criterion for receiving a high school tuition scholarship

Figure 4 shows that the proportion of students in academic high schools increases, as expected, with exam scores. Thus, each additional point raises the proportion of students in academic high schools by 1.8 percentage points on average. However, at the transition from 70 to 71 the proportion of students in academic high schools increases by 11.5 percentage points, which far exceeds the trend. Therefore, it appears that a score of 70 constituted a significant threshold.

Figure 4
Proportion of Students in Academic Education by *Seker* Examination Score
 (percent)



It is not sufficient to simply identify the threshold in order to use the regression discontinuity method. It also needs to be shown that in the vicinity of the threshold, there are no significant differences in the characteristics of students and their families that might affect the outcome variables. Figure A1 in the Appendix presents the sociodemographic characteristics of the students who received scores between 68 and 73 on the exam (the shaded area in Figure 4). Although, as one might expect, the average characteristics of the students who received a score of 70 or less were weaker than those of the students who received a higher score, the differences were relatively small.¹⁴

The median exam score of 70 represents the 68th percentile for students in vocational high schools and the 30th percentile for students in academic high schools (see also Figure 1), which indicates intermediate cognitive abilities, i.e. the intermediate to strong students in vocational high schools and the intermediate to weak students in academic high schools. It can be hypothesized that if a vocational education in fact reduces the relative probability of educational achievement and success in the labor market, the effect on graduates of vocational high schools with cognitive abilities similar to those of students who received scores of 68-73 was relatively larger since

¹⁴ An exception was the proportion of mothers of Asian-African descent for native-born students (Part b Figure A1 in the Appendix). This proportion was much higher among students with a score equal to or below the threshold, which is due to the particularly high correlation between Asian-African descent and each of the other characteristics and is likely to be an indicator of a weak socioeconomic background (such as parents with a low level of education and a large number of siblings).

they apparently had abilities that would have allowed them to succeed in an academic high school.

The results of the first stage of the TSLS estimation for students who received a score of between 68 and 73 are presented in Table 7. The estimation included background variables, as well as an instrumental variable: a dummy variable that receives a value of 1 if the student's score is above 70. The probability of attending a vocational high school is lower by about 10 percentage points for students with a score of below 70. The value obtained in an F-test was 11.2 (>10) and therefore the use of the instrumental variable was valid (Bound et al., 1995). Table A6 in the Appendix shows that a "placebo" threshold score does not affect the probability of attending a vocational high school.

Table 7
The Effect of a Score above 70 on the Probability of Attending a Vocational Education
First-Stage TSLS Equation, Score Range of 68-73

	Score above 70	Number of observations	Adjusted R ²
Vocational education	-0.104*** [0.027]	1,265	0.10

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings and year of Seker examination (cohort).

Table 8 presents the results for the reduced-form estimation and the second-stage equations, in the score range of 68-73. It appears that the instrumental variable affects some of the outcome variables and this effect is statistically significant: the probability of completing a first degree for a student who received a score of over 70 was 3.5 percentage points higher than that for a student with a lower score; his probability of working in a high-status occupation was 6.3 percentage points higher; and his hourly wage was 12.1 percent higher. The placebo tests, shown in Table A7 in the Appendix, did not show any effect for the placebo threshold score on the outcome variables.

The results of the second-stage equations show that a vocational relative to an academic education has a positive and statistically significant effect on the probability of completing high school,¹⁵ in contrast to the negative effects found in the OLS and PSM estimations. Nonetheless, in the OLS estimation, the estimated effect of a vocational education on the completion of high school was not significant in the score range of 68-73.¹⁶ According to the second-stage equation, the relative contribution of

¹⁵ When the completion of high school is defined as 12 years or more of schooling, the estimated effect is negative and not significant.

¹⁶ The estimates of the effect of a vocational education on all the other outcome variables are significant and similar in magnitude to those obtained in the estimations for all students (including the completion of high school according to 12 years or more of schooling) and not only those in the 68-73 score range.

vocational education to hourly wages and employment is not statistically significant as opposed to the relative disadvantage found in the other methods (except for the lack of a statistically significant effect on employment using the PSM method).

The second-stage equations reveal a negative effect of vocational relative to academic education on the other outcome variables, as with the other estimation methods. Thus, the probabilities of attaining a first degree, of entering a high-status occupation and of achieving a high hourly wage were all reduced.¹⁷ The magnitude of vocational education's negative effect is larger than that found using other methods, as was the variance of the estimates, which are familiar phenomena in TSLS estimations.

Table 8
The Effect of Vocational versus Academic Education and a Score over 70 on
Educational Achievements and Labor Market Success
Second-Stage TSLS and Reduced-Form Equations, Score Range of 68-73

	<u>Second stage</u> <u>Vocational</u> <u>education</u>	<u>Reduced-form</u> <u>Score over 70</u>	<u>Number of</u> <u>observations</u>	<u>Adjusted R²</u>
High school completion	0.308* [0.180]		1,265	0.052
		-0.027 [0.016]	1,265	0.002
Academic degree	-0.350* [0.191]		1,265	0.000
		0.035* [0.019]	1,265	0.003
Employment	-0.085 [0.179]		1,265	0.047
		0.008 [0.019]	1,265	0.000
High-status occupation¹	-0.716* [0.378]		1,118	0.000
		0.063** [0.029]	1,118	0.004
Monthly wage	-0.65 [0.715]		958	0.080
		0.025 [0.046]	958	0.000
Hourly wage	-1.884* [1.065]		908	0.000
		0.121*** [0.044]	908	0.008

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings and year of Seker examination (cohort).

1) High-status occupations: Academic professionals, associate professionals and managers.

Therefore, it can be concluded that the differences in the outcomes between the TSLS and OLS estimations for all students are not the result of differences in the population of students.

¹⁷ Similar results were obtained when the score range was expanded to 67-74.

A substantive explanation for the large size of the estimates is that the effect of vocational education using the TSLS method is unique to the population that was affected (Local Average Treatment Effect). Thus, students who could have been accepted to an academic high school if their scores had been higher by one point and instead went to a vocational high school have unexploited abilities that would have enabled them to succeed in an academic high school and therefore the harm to them is relatively large.

Additional explanations for the unusually large magnitude of the estimates may be that the prerequisites for using the regression discontinuity method were not fulfilled in the first place. Firstly, the monotonicity of the effect of the exam score on the probability of attending a vocational high school was violated at some of the points in the vicinity of the threshold. Thus, for example, the frequency of the score 69 was lower than expected according to the trend while the frequency of the score 70 was higher, a phenomenon that perhaps biased the results. However, even after the students with a score of 69-70 are omitted from the estimations, the direction of the effects remains unchanged and they are of a similar magnitude.

Secondly, it is possible that in the vicinity of the threshold there was intentional intervention, which may have been positively correlated with ability. Thus, for example, talented students who had the bad luck to achieve an initial score slightly below the threshold may have had their scores artificially raised. In this way, the negative effect of vocational education is intensified. However, the fact that, when using the regression discontinuity method, vocational education in fact had a positive effect on the probability of completing high school reduces the likelihood of this intervention scenario.

In order to deal with the problems presented above, a two-stage estimation was performed using a different method (see the Methodology Appendix for details). In the first stage, the probability of attending a vocational high school is estimated using an instrumental variable that embodies the excess effect of the exam score on the probability in the score range between 70 and 80. Most academic high schools set their acceptance threshold within this range, as the first-stage results demonstrate (not shown).

The results of the second-stage equations (Table A8 in the Appendix) show that vocational as compared to academic education has a positive and statistically significant effect on completing high school, as with the regression discontinuity method. The relative contribution of vocational education to monthly wages and employment was not statistically significant, as was the case with hourly wages, which is in contrast to the regression discontinuity findings. Vocational education has a relatively negative effect on the probability of acquiring a first degree and entering a high-status occupation. Similar findings were produced by the regression discontinuity method although with lower magnitudes.

In sum, although the magnitude of the effect of vocational education on most of the outcome variables differed between the two two-stage estimation methods, the

following conclusions can be drawn, despite the methodological problems, with regard to the directions of the effects that are common to both: vocational education made a relative contribution to preventing drop-outs but reduced the probability of acquiring a first degree or higher and of entering a high-prestige occupation. The findings regarding wages point to the absence of a statistically significant effect or a negative effect for vocational education.

6. Conclusion

Vocational education is a major component of the high school education system in Israel. There is a longstanding debate as to the optimal scope of vocational education and its curriculum. The supporters of vocational education claim that it allows those who would have had difficulty succeeding in an academic high school, and perhaps would have dropped out of the education system, to acquire a profession and earn a decent living. From a macro-economic perspective, it provides a solution to the shortage of technical manpower. The opponents of vocational education maintain that in an era of rapid technological change it is preferable for students to acquire general human capital and that vocational education could cause stigma and exclusion, thus reducing graduates' chances of obtaining a higher education and entering well-paid occupations.

This study has examined the effect of vocational versus academic high school studies on a number of outcome variables that are related to educational achievement and success in the labor market.

The study's database is composed of the scores on exams given to all Jewish students in Grade 8, which were used to classify students into high school tracks, and questionnaires on the student's family background and his preferences for continuing his studies. These were matched with the Population and Housing Census for 1983 and 1995, when the individuals were in their early 30s and/or 40s.

The choice of educational track is selective – those entering vocational high schools are on average from a relatively weak socioeconomic background and have lower cognitive abilities. Therefore, use was made of various estimation methods: OLS which included a large variety of explanatory variables that are correlated with the choice of educational track; propensity score matching; and regression discontinuity in the probabilities of being accepted to an academic high school as dependent on the student's examination score.

The findings of all the estimation methods show that in most cases the achievements of graduates of vocational high schools were much lower than those of similar graduates of academic high schools. Thus, they attained less post-secondary education and were less likely to enter high-status occupations. For most of the estimation methods, it was found that their wages were also lower. The aforementioned findings are valid even for individuals with relatively low cognitive abilities, who traditionally

have constituted the target population for vocational education. The OLS findings also indicated a negative effect of vocational relative to academic education on employment although this effect disappears for the other two estimation methods, which are more effective in dealing with the problems of selection bias and unobservable variables. The results for the effect of vocational relative to academic education on high school drop-out rates were not unambiguous. Thus, while the OLS and PMS results showed a negative effect, the results of the regression discontinuity method either did not show any differences or were in favor of the vocational high schools. This finding is consistent with one of the main goals of vocational education and with the findings of research done in other countries.

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Appendix

Table A.1
The Effects of Vocational versus Academic Education on
Educational Achievements and Labor Market Success, by Gender
OLS

A. Men				
	Vocational education	Seker score	Number of observations	Adjusted R²
High school completion	-0.057*** [0.011]		4,276	0.05
	-0.007 [0.011]	0.006*** [0.000]	4,272	0.08
Academic degree	-0.276*** [0.013]		4,276	0.19
	-0.174*** [0.013]	0.011*** [0.001]	4,272	0.28
Employment	-0.014 [0.008]		4,276	0.01
	-0.008 [0.008]	0.001* [0.000]	4,272	0.01
High-status occupation¹	-0.190*** [0.016]		3,908	0.11
	-0.082*** [0.016]	0.012*** [0.001]	3,904	0.18
Monthly wage	-0.174*** [0.025]		3,258	0.06
	-0.070*** [0.026]	0.012*** [0.001]	3,254	0.10
Hourly wage	-0.169*** [0.027]		2,982	0.04
	-0.063** [0.029]	0.012*** [0.001]	2,978	0.08
B. Women				
	Vocational education	Seker score	Number of observations	Adjusted R²
High school completion	-0.083*** [0.010]		4,641	0.07
	-0.045*** [0.011]	0.005*** [0.000]	4,627	0.09
Academic degree	-0.204*** [0.011]		4,641	0.19
	-0.105*** [0.011]	0.011*** [0.000]	4,627	0.29
Employment	-0.092*** [0.012]		4,641	0.04
	-0.052*** [0.012]	0.005*** [0.001]	4,627	0.05
High-status occupation¹	-0.247*** [0.016]		3,837	0.12
	-0.155*** [0.017]	0.010*** [0.001]	3,823	0.17
Monthly wage	-0.244*** [0.026]		3,360	0.05
	-0.091*** [0.027]	0.017*** [0.001]	3,347	0.11
Hourly wage	-0.254*** [0.026]		3,259	0.06
	-0.098*** [0.027]	0.017*** [0.001]	3,247	0.12

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.

1) High-status occupations: Academic professionals, associate professionals and managers.

Table A.2
The Effects of Vocational versus Academic Education on
Educational Achievements and Labor Market Success,
Students with Low Educational Achievements
OLS

A. Seker examination score below 60				
	Vocational education	Exam score	Number of observations	Adjusted R²
	-0.061***		2,107	0.02
	[0.023]			
High school completion	-0.060***	0.006***	2,107	0.03
	[0.023]	[0.002]		
	-0.029***		2,107	0.03
	[0.007]			
Academic degree	-0.028***	0.001*	2,107	0.03
	[0.007]	[0.001]		
	-0.024		2,107	0.09
	[0.021]			
Employment	-0.023	0.005***	2,107	0.10
	[0.021]	[0.002]		
	-0.085***		1,673	0.02
	[0.022]			
High-status occupation¹	-0.084***	0.004**	1,673	0.02
	[0.022]	[0.002]		
	-0.147***		1,425	0.29
	[0.040]			
Monthly wage	-0.141***	0.015***	1,425	0.30
	[0.040]	[0.003]		
	-0.114***		1,316	0.08
	[0.043]			
Hourly wage	-0.111**	0.017***	1,316	0.10
	[0.043]	[0.003]		
B. No university degree				
	Vocational education	Seker score	Number of observations	Adjusted R²
	-0.045***		6,958	0.06
	[0.009]			
High school completion	-0.027***	0.003***	6,942	0.07
	[0.009]	[0.000]		
	-0.139***		5,938	0.05
	[0.012]			
Academic degree	-0.085***	0.008***	5,922	0.09
	[0.013]	[0.001]		
	-0.119***		5,048	0.21
	[0.020]			
Employment	-0.038*	0.012***	5,033	0.24
	[0.020]	[0.001]		
	-0.130***		4,761	0.04
	[0.021]			
High-status occupation¹	-0.043**	0.012***	4,747	0.08
	[0.022]	[0.001]		
	-0.244***		3,360	0.05
	[0.026]			
Monthly wage	-0.091***	0.017***	3,347	0.11
	[0.027]	[0.001]		
	-0.254***		3,259	0.06
	[0.026]			
Hourly wage	-0.098***	0.017***	3,247	0.12
	[0.027]	[0.001]		

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.

1) High-status occupations: Academic professionals, associate professionals and managers.

Table A.3
The Effect of Vocational versus Academic Education on
Educational Achievements and Labor Market Success, 1983 Census
 (Students later included in the 1983 and 1995 censuses)
OLS

	Vocational education	Seker score	Number of observations	Adjusted R ²
	-0.048**		1,476	0.28
	[0.024]			
High school completion	0.026	0.009***	1,475	0.33
	[0.033]	[0.001]		
	-0.229***		1,476	0.31
	[0.025]			
Academic degree	-0.161***	0.008***	1,475	0.36
	[0.022]	[0.001]		
	-0.067***		1,476	0.27
	[0.022]			
Employment	-0.032	0.004***	1,475	0.28
	[0.022]	[0.001]		
	-0.292***		1,070	0.31
	[0.039]			
High-status occupation¹	-0.189***	0.012***	1,070	0.37
	[0.037]	[0.001]		
	-0.110***		942	0.35
	[0.041]			
Monthly wage	-0.026	0.010***	942	0.38
	[0.042]	[0.002]		
	-0.156***		861	0.29
	[0.043]			
Hourly wage	-0.062	0.011***	861	0.32
	[0.046]	[0.002]		

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.

1) High-status occupations: Academic professionals, associate professionals and managers.

Table A.4
The Effects of Vocational versus Academic Education on
Labor Market Success, by Gender
High School Graduates, 1983 Census
OLS

A. Total				
	Vocational education	Seker score	Number of observations	Adjusted R²
	-0.050***		5,257	0.17
	[0.012]			
Employment	-0.025**	0.004***	5,245	0.18
	[0.013]	[0.001]		
	-0.018		3,668	0.02
	[0.013]			
High-status occupation¹	0.005	0.004***	3,663	0.03
	[0.013]	[0.001]		
	-0.029		3,154	0.18
	[0.025]			
Monthly wage	0.037	0.010***	3,150	0.21
	[0.026]	[0.001]		
	-0.016		2,864	0.04
	[0.027]			
Hourly wage	0.039	0.008***	2,860	0.06
	[0.027]	[0.001]		
B. Men				
	Vocational education	Seker score	Number of observations	Adjusted R²
	-0.003		2,591	0.01
	[0.013]			
Employment	0.004	0.001**	2,585	0.01
	[0.013]	[0.000]		
	-0.059***		2,135	0.03
	[0.018]			
High-status occupation¹	-0.027	0.005***	2,130	0.05
	[0.019]	[0.001]		
	0.03		1,836	0.03
	[0.034]			
Monthly wage	0.090***	0.009***	1,832	0.06
	[0.034]	[0.001]		
	0.036		1,590	0.01
	[0.040]			
Hourly wage	0.090**	0.008***	1,586	0.03
	[0.040]	[0.001]		
C. Women				
	Vocational education	Seker score	Number of observations	Adjusted R²
	-0.085***		2,666	0.02
	[0.020]			
Employment	-0.038*	0.007***	2,660	0.04
	[0.021]	[0.001]		
	0.024		1,533	0.03
	[0.017]			
High-status occupation¹	0.032*	0.001	1,533	0.03
	[0.018]	[0.001]		
	-0.085**		1,318	0.02
	[0.037]			
Monthly wage	-0.01	0.011***	1,318	0.05
	[0.039]	[0.002]		
	-0.059*		1,274	0.02
	[0.036]			
Hourly wage	-0.004	0.008***	1,274	0.04
	[0.038]	[0.002]		

Standard errors, clustered by student's area of residence, are reported in parentheses.
* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.
All the regressions control for immigrant status, parents' continent of birth, parents' education, number of pupil's siblings, year of Seker examination (cohort) and fixed effect for area of residence.
1) High-status occupations: Academic professionals, associate professionals and managers.

Table A.5
The Effect of Vocational versus Academic Education on
Educational Achievements and Labor Market Success
Seker Examination Score Below 70
PSM (0.001 caliper width)

High-school completion	-0.04** [0.018]
Academic degree	-0.06*** [0.010]
Employment	-0.015* [0.011]
High-status occupation¹	-0.12*** [0.03]
Monthly wage	-0.07* [0.04]
Hourly wage	-0.06* [0.04]

Standard errors are reported in parentheses.

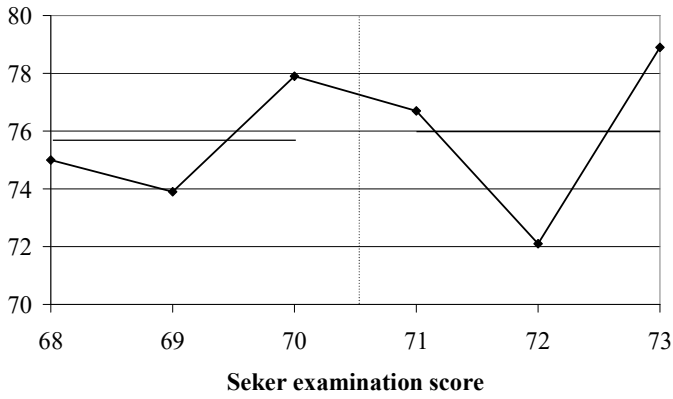
* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

1) High-status occupations: Academic professionals, associate professionals and managers.

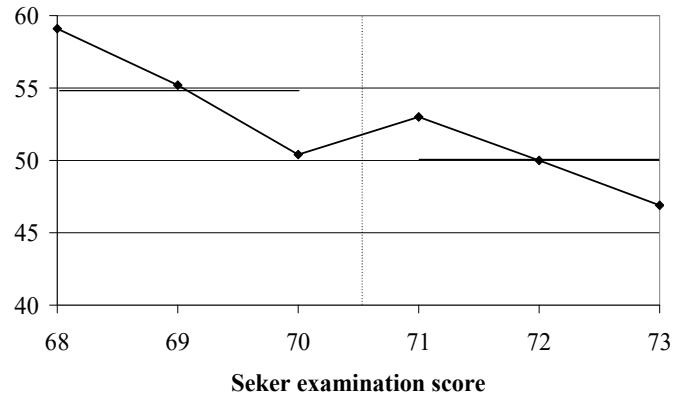
Figure A.1

Socio-demographic Characteristics according to the *Seker* Examination Score (percent)

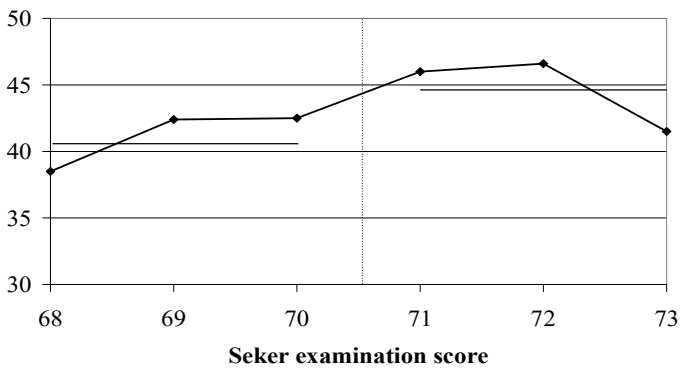
a. Born in Israel



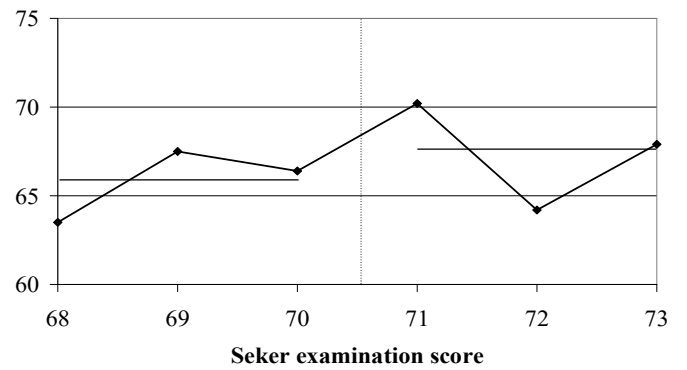
b. Mother of Asian-African origin¹



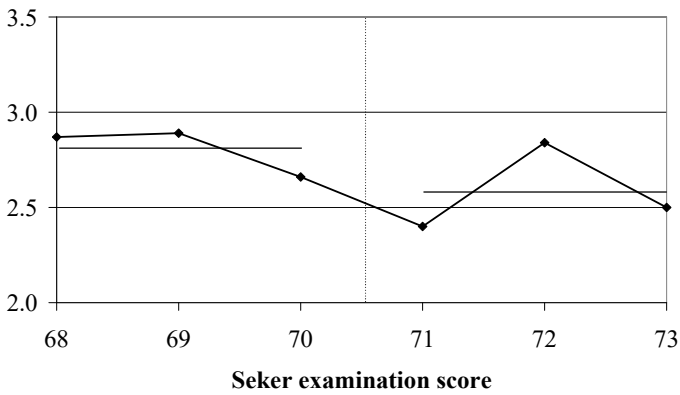
c. Father with post-secondary education or higher



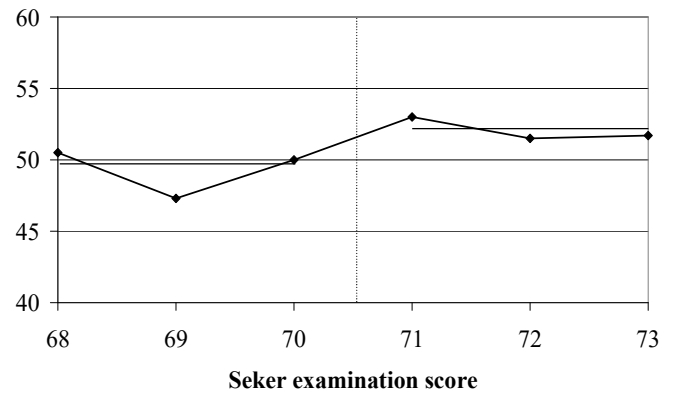
d. Mother with post-secondary education or higher



e. Number of siblings



f. Girls



1) For students born in Israel.

Table A.6
Effect of Placebo Threshold (Score of 64) on Probability of Attending a Vocational High-School
First-Stage TSLS Equation, Score Range of 62-67

	Score above 64	Number of observations	Adjusted R²
Vocational education	-0.014 [0.026]	1,290	0.076

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All the regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings and year of Seker examination (cohort).

Table A.7
The Effects of Vocational versus Academic Education and Score above 64 on
Educational Achievements and Labor Market Success
Second-Stage TSLS and Reduced-Form Equations, Score Range of 62-67

	<u>Second-stage</u> <u>Vocational</u> <u>education</u>	<u>Reduced-form</u> <u>Score over 70</u>	<u>Number of</u> <u>observations</u>	<u>Adjusted R²</u>
High school completion	0.612 [1.829]		1,290	0.000
		-0.005 [0.020]	1,290	0.000
Academic degree	-0.37 [1.066]		1,290	0.000
		0.009 [0.013]	1,290	0.000
Employment	-1.204 [2.588]		1,290	0.000
		0.017 [0.020]	1,290	0.001
High-status occupation¹	-1.046 [1.129]		1,102	0.000
		0.043 [0.027]	1,102	0.002
Monthly wage	0.113 [1.287]		954	0.191
		0.001 [0.045]	954	0.000
Hourly wage	-1.011 [0.987]		889	0.000
		0.059 [0.045]	889	0.002

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All second-stage regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings and year of Seker examination (cohort).

1) High-status occupations: Academic professionals, associate professionals and managers.

Table A.8
The Effect of Vocational versus Academic Education on
Educational Achievements and Labor Market Success
Second-Stage TSLS Estimation Using Instrumental Variables for Excess Effect of Scores in the Range of 70-80
on the Probability of Attending a Vocational High-School

	Estimator	Number of observations
High school completion	-0.076*** [0.007]	8,917
Academic degree	-0.251*** [0.011]	8,917
Employment	-0.051*** [0.007]	8,917
High-status occupation¹	-0.223*** [0.014]	7,745
Monthly wage	-0.228*** [0.019]	6,618
Hourly wage	-0.227*** [0.022]	6,241

Standard errors, clustered by student's area of residence, are reported in parentheses.

* Significant at 10% level; ** Significant at 5% level; *** Significant at 1% level.

All second-stage regressions control for gender, immigrant status, parents' continent of birth, parents' education, number of pupil's siblings and year of Seker examination (cohort).

1) High-status occupations: Academic professionals, associate professionals and managers.

Methodological Appendix

Two-stage estimation of the effect of vocational relative to academic education on outcome variables: use of an instrumental variable for the excess effect of receiving a score in the range of 70-80

In the score range of between 70 and 80 on the *Seker* examinations, each additional point reduces the probability of attending a vocational high school considerably since most of the academic high schools set their acceptance threshold in this range.

Therefore, the first-stage equation (Equation 1) estimated the probability of attending a vocational high school (*MIK*) as dependent on a dummy variable for a score between 70 and 80 (*d70_80*), the *Seker* exam score (*Grade*) and the student's characteristics and those of his family (*X*), as well as the interaction between the dummy variables and the exam score that reflects the excess effect of an additional point in the range between 70 and 80 on the probability of attending a vocational high school, which is beyond the effect of the score in the whole range of scores.

$$(1) \text{MIK}_i = \lambda + \theta_1[\text{Grade} * d70_80] + \theta_2 d70_80 + \theta_3 \text{Grade} + \theta_4 X_i + \varepsilon_i$$

The second stage involved the estimation of Equation 2, in which the predicted value of the vocational education variable from the first stage explains the outcome variables, while controlling for all the variables that appeared in the first stage and omitting the interaction variable.

$$(2) Y_i = \eta + \delta_1 \hat{\text{MIK}}_i + \delta_2 d70_80 + \delta_3 \text{Grade} + \delta_4 X_i + u_i$$