Bank of Israel **Research Department**

The Wage Premium on Higher Education: Universities and Colleges

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Discussion Paper 2018.13
December 2018

Bank of Israel http://www.boi.org.il

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The study received financial support from the Pinchas Sapir Economic Policy Forum.
We would like to thank David Gordon, Anat Katz-Avram and Adnan Mansour of the Central Bureau of Statistics for preparing the data and making them accessible to us in the Bureau's research room. We would also like to thank Zeev Krill from the Chief Economist Department of the Ministry of Finance for the initiative to set up the database we used for the study, and Michal Ophir and Hava Klein-Avishai of the Council for Higher Education for providing us with data.
We are also grateful to Osnat Lipshitz and the participants of the Bank of Israel Research Department seminar for their helpful comments.

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The Wage Premium on Higher Education: Universities and Colleges

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Abstract

The study examined the wage premium on higher education obtained at different types of institution in Israel. It tracked all those born between 1978 and 1985, and relied on a variety of demographic and socioeconomic characteristics of the students and their families, achievements in matriculation and psychometric tests, academic education data, and wages over the years. The databases drew from administrative files and population censuses. In order to distinguish between return on institutions and return on abilities, we used three methods: OLS (selection on observables, including among siblings); TSLS using "geographic proximity to the educational institution" as an IV; and fuzzy regression discontinuity in the acceptance of candidates to departments in the higher education institutions.

We first conducted estimations among individuals who completed a Bachelor's or Master's degree. The OLS estimation shows that, all else being equal, the gross annual wage among university graduates between 2008 and 2015 was about 10 percent higher than that of public college graduates, and wages among graduates of private colleges were about 6–7 percent higher. The wage gaps remained stable even after breaking down the data by the year in which the degree was completed and the number of years that have elapsed since then. The ranking of annual wage was maintained when broken down by gender, nationality, and parental income. The gross hourly wage among university graduates was similar in 2008 to the wage among graduates of private colleges, and about 4–6 percent higher than the wages of graduates of public colleges.

We also conducted estimations among those with just a Bachelor's degree. The OLS estimation showed that the annual wage of graduates of universities and private colleges was about 10 percent higher than the wage of public college graduates. The TSLS method shows that graduates of universities and private colleges earn about 20 percent more and 14 percent more than graduates of public colleges, respectively. In the fuzzy regression discontinuity method, no differences were found between the wages of graduates of elite universities and other universities. When we compared those with Bachelor's degree and those with just a matriculation certificate, we found that studying at public colleges generates a high return, although there are differences between institutions.

The findings show that in every field of study, the type of institution is ranked differently in terms of graduates' wages. However, the annual and hourly wages of engineering graduates and those of para-medical professions are higher if they study at universities, while the opposite is true for business management.

התשואה במונחי שכר להשכלה הנרכשת באוניברסיטאות ובמכללות

לאה אחדות, אלעד גוטמן, נעם זוסמן, עידן ליפינר וענבל מעין

תקציר

המחקר בחן את התשואה במונחי שכר להשכלה הגבוהה הנרכשת בסוגי המוסדות השונים בישראל. לשם כך הוא עקב אחר כל ילידי 1978—1985 והסתמך על מגוון מאפיינים דמוגרפיים-חברתיים-כלכליים שלהם ושל משפחותיהם, הישגיהם בבחינות הבגרות ובבחינה הפסיכומטרית, השכלתם האקדמית ושכרם לאורך השנים; נתונים אלה לקוחים מקבצים מִנהליים וממפקדי האוכלוסין. כדי לזהות את התשואה לפי סוג מוסד יש לבודד את התשואה להשכלה הנרכשת בו מהתשואה לכישורים האישיים, שכן תלמידים מוכשרים בדרך כלל לומדים במוסדות איכותיים. עשינו זאת בשלוש שיטות: אמידה מרובת משתנים (בגישת הבחירה על הנצפים, לרבות בקרב אחאים); אמידה דו-שלבית שמשתמשת במשתנה העזר "קרבה גאוגרפית למוסד הלימודים"; ואי-רציפות בקבלה לחוגי הלימודים שהמועמדים נרשמו אליהם.

תחילה ערכנו אמידות בקרב פרטים שהשלימו תואר ראשון ותואר שני. האמידה מרובת המשתנים מלמדת כי כשיתר הדברים קבועים, השכר השנתי ברוטו בקרב בוגרי האוניברסיטאות עלה ב-2008—2015 בכ-10% על השכר המקביל בקרב בוגרי המכללות הציבוריות, והשכר בקרב בוגרי המכללות הפרטיות עלה עליו ב-6%—7%. פערי השכר נותרו יציבים גם לאחר שפילחנו את הנתונים לפי שנת סיום התואר ומספר השנים שחלפו מאז. מדרג השכר השנתי נשמר בחלוקות לפי המגדר, הלאום והכנסת ההורים. השכר השעתי ברוטו בקרב בוגרי האוניברסיטאות דמה ב-2008 לשכר המקביל בקרב בוגרי המכללות הפרטיות ועלה בכ-4%—6% על שכרם של בוגרי המכללות הציבוריות.

נוסף לכך ערכנו אמידות בקרב בעלי תואר ראשון בלבד. האמידה מרובת המשתנים העלתה כי שכרם השנתי של בוגרי האוניברסיטאות והמכללות הפרטיות גבוה בכ-10% משכרם של בוגרי המכללות הציבוריות; השיטה הדו-שלבית מראה כי בוגרי האוניברסיטאות והמכללות הפרטיות משתכרים, בהתאמה, כ-20% וכ-14% יותר מבוגרי המכללות הציבוריות; בשיטת אי-הרציפות גם כן לא נמצאו הבדלים בין בוגרי אוניברסיטאות העילית והאוניברסיטאות האחרות. עם זאת, כאשר השווינו בין בעלי תואר ראשון לבעלי תעודת בגרות בלבד, מצאנו כי לימודים במכללות הציבוריות מניבים תשואה נאה, הגם שקיימים הבדלים בין המוסדות.

הממצאים מעידים שבכל מקצוע סוגי המוסדות מדורגים אחרת מבחינת השכר. אולם בכל זאת ניתן לומר ששכרם השנתי והשעתי של בוגרי הנדסה ומקצועות עזר רפואיים גבוה יותר אם הם לומדים באוניברסיטאות, ואילו במִנהל עסקים שכרם של בוגרי המכללות גבוה יותר.

1. Introduction

The proportion of Israelis who have acquired higher education has increased almost three-fold since the early 1990s, and Israel currently ranks very high among OECD members in terms of the percentage of college and university graduates in its population (OECD, 2018). However, Israel ranks low among OECD members in terms of both labor productivity and economic growth rate (Figure A-1 in the Appendix; Regev and Brand, 2015; Bank of Israel, 2016a).

This difference requires explanation, since according to the economic literature, education significantly increases labor productivity—and, as a result, economic growth[1]—since education imparts skills and improves the ability to adopt advanced technologies and work methods (see, for example, Brand and Regev, 2015; Bank of Israel 2016b; Hazan and Tsur, forthcoming). Therefore, the explanations offered by researchers for the Israeli situation have included, inter alia, inadequate quality of education—especially among populations that have rapidly increased their participation rates in the labor market, including ultra-Orthodox men and Arab women.[2] The explanation regarding the quality of education is the focus of this study. An international survey has shown that the skill level of adult Israelis, including college and university graduates, is much lower than that of their peers in Western countries (OECD, 2016). It may very well be, therefore, that labor productivity does not reflect the proliferation of higher education, since the latter does not create a solid basis for acquiring skills, especially those needed for the labor market.[3]

In the past few decades, higher education in Israel has expanded, mainly thanks to the college revolution:[4] The number of colleges, both public and private, has risen from 13 in the early 1990s to 32 in 2017. The number of undergraduate students during that period grew from 50,000 to approximately 200,000, with the percentage of new students aged 20–29 rising from 6 percent to 17 percent. In the early 1990s, colleges (with the exception of education colleges) featured a negligible percentage of undergraduate students, while currently they make up almost half. Moreover, in recent years, colleges have also increased the number of their graduate

[1] A discussion of the Israeli case appears in Argov (2017).

[2] Some of the studies focused on productivity—and wage—gaps among the various industry sectors, offering explanations which highlight the characteristics of the industries and their workers, including tradability and export rates, the extent to which technology is used and percentage of college and university graduates.

[3] Hanushek and Woessmann (2012) show that economic growth correlates with the quality of education, especially in its early stages, more than with its quantity (number of schooling years).

[4] This revolution was documented by Wilensky, 2005. Doubtless, the immigration wave from the former Soviet Union contributed to the revolution, since it occurred during the same period and significantly boosted demand for higher education.

students (for M.A. degrees), which currently account for more than 20 percent of all graduate students.

The accelerated growth of the colleges may widen the quality advantage of the universities. This could have been caused by two major processes: (a) The accelerated growth forced the colleges to quickly hire new staff and employ many non-faculty lecturers, as well as to quickly create a learning infrastructure; (b) The colleges gave opportunity to many of the population groups that previously had been underrepresented in universities, such as Arabs, residents of Israel's geographical periphery and graduates of vocational high schools. The universities, on the other hand, sometimes raised their admissions criteria, since—as a result of planning considerations of the higher education system—they did not increase the number of students despite the greater demand for their services; they were thus able to maintain high standards and even further reinforce them through peer effects.

Many studies from Western countries show a correlation between the quality of higher education and success in the labor market, and many of these studies focus on return in terms of wages.[5] In the next section, we review them in depth and outline their main findings. Worldwide, graduates of selective institutions have been found to earn up to 20 percent more, after controlling for their personal characteristics, including cognitive abilities. Zussman, et al. (2007) researched Israel, focusing on the first month's wages post-graduation; they found that university graduates were earning about 7 percent and 13 percent more than graduates of private and public colleges, respectively, after controlling for their personal characteristics. Krill, et al. (2018) focused on certain departments and their students' average psychometric score—a measure of their quality; they showed that when the average score in the department goes up by 10 percent, all else being equal, the graduates' pay goes up by 5 percent.

This study also focuses on the correlation between the quality of education and wage differences: It examines how the return on an academic degree varies by the type of higher education institution and academic subject studied.

We tracked all those born between 1978 and 1985 using administrative data on a variety of their (and their families') demographic and socioeconomic characteristics, as well as their matriculation grades and psychometric test scores, their applications to higher education institutions, their academic subjects and degrees, as well as their wages in 2008–15 (when aged 23–37), etc. We classified the higher education institutions into five groups[6]: (a) Elite

[5] For the sake of brevity, we often use the term "wages" while always meaning wage premium, i.e., wages after controlling for personal characteristics.
[6] The database at our disposal does not identify the institutions.

universities (Tel Aviv University, the Hebrew University, the Technion and the Weizmann Institute of Science); (b) Other universities; (c) Public (state-subsidized) colleges; (d) Private (non-subsidized) colleges; (e) Colleges of education.

The difficulty in identifying the return by academic institution stems from the admissions selection process: Since talented students usually study at high quality institutions, one should distinguish between the return on abilities and the return on the human capital acquired at an educational institution. To overcome the selectivity problem, we used three estimation methods: (1) Multivariate estimation (taking the selection on observables approach), including comparison among siblings, i.e., individuals with similarities both in terms of personal abilities and the environment in which they grew up. (2) Two-Stage least squares estimation (TSLS), using the instrumental variable "geographic proximity to the higher educational institution". This variable takes advantage of the fact that colleges were founded and established their departments gradually and in a geographically uneven way, thus creating time and space variance in terms of educational accessibility. (3) Discontinuity in admissions to an academic departments (fuzzy regression discontinuity). Underlying this method is the idea that if candidates were found to be slightly below the admissions threshold of a department in a particular type of institution—and therefore were forced to study the same subject in another type of institution—their characteristics are highly similar to those of candidates who were only slightly above the thresholds, and therefore the wage gaps between the two groups can reflect the return on studying in that type of institution. The last two methods are more accurate. However, studies show that the first method yields similar results when incorporating into the estimations multiple explanatory variables that are correlated with the selectivity (especially personal abilities), as was done here.

Following are our main findings regarding individuals who have earned academic degrees (Bachelor's or Master's degrees): The multivariate OLS estimation shows that the gross annual wages among university graduates between 2008 and 2015 was about 10 percent higher than that of public college graduates, and wages among graduates of private colleges were 6–7 percent higher. The wage gaps remained stable even after breaking down the data by graduation year and the number of years that have elapsed. The annual wage hierarchy remained the same when broken down by gender, nationality, and parental income; exceptions to the rule are graduates of private colleges whose parents are well-off, who earned more than university graduates. The gross hourly wage among university graduates was similar in 2008 to the wage among graduates of private colleges, and about 4–6 percent higher than the wages of public college graduates.

The estimations made among graduates with bachelor's degrees only, which can be done using the three estimation methods, yielded the following findings: The OLS estimation showed that the annual wage of graduates of universities and private colleges was about 10 percent higher than the wage of public college graduates. The TSLS method shows that graduates of universities and private colleges earn about 20 percent more and 14 percent more than graduates of public colleges, respectively. When applying the fuzzy regression discontinuity method to admissions to academic departments, no differences were found between the wages of graduates of the "elite universities" and "other universities".[7]

The multivariate estimation and the TSLS method show that in every academic subject, types of institutions are ranked differently in terms of graduates' wages. However, the annual and hourly wages of engineering graduates and those of para-medical professions are higher if they study at universities, while graduates of business administration programs at colleges earn more.

When we compared individuals with bachelor's degrees to those with only a high school diploma, we found, among other things, that there are differences between institutions of the same type, and that studying at public colleges yields a high wage premium: Among computer science graduates, the annual wages are 80 percent higher than among those with a high school diploma; among engineering graduates, wages are about 60 percent higher; and among social science and business administration graduates—about 30 percent higher.

The study contributes to the literature in several aspects. First, it boosts the reliability of estimates of returns on the education acquired at the various types of academic institutions: it is based on a large, nationwide population and uses a rich, high-quality database and several estimation methods, while most studies were based on a small population, the information about which was limited, and made multivariate estimations (the selection on observables method). Second, it monitors the development of return over time—a topic that has hitherto received little research attention—because it has had many graduate cohorts at its disposal. Finally, the study estimates the return more accurately due to the use of instrumental variables and discontinuities in the admissions to the academic departments—methods less frequently used in this field.

Before we continue, we shall emphasize that the wage premium is not the only measure, or even the most important one, to evaluate the outcomes of a higher education system. Higher education also expands horizons and contributes to satisfaction, social mobility (see Ministry

[7] We used this method only for university graduates due to limited data.

of Finance, 2017), etc. Moreover, higher education institutions, especially universities, also devote considerable resources to research, whose outcomes expands knowledge and can advance the economy and society as a whole.

The study is structured as follows: Section 2 reviews the literature; Section 3 describes the databases and research population and presents descriptive statistics; Section 4 presents the methodology; Section 5 presents the estimation results and Section 6 concludes.

2. Literature review[8]

Extensive literature focuses on the correlation between the quality of higher education institutions and the employment and wages of their graduates immediately after graduation and later on throughout their careers; few studies have also examined additional outcome variables, such as job status (salaried employee or self-employed), occupational prestige, and job satisfaction. This type of literature has greatly expanded since the mid-1990s. (Literature reviews appear in Oreopoulos and Petronijevic, 2013; Milla, 2017.)

Most studies determine the quality of the institutions (or department) by their average or median admissions scores. To illustrate, in Israel, these studies use matriculation grades and psychometric test scores, and in the US—SAT scores and GPA. These metrics are not only acceptable but also available, but it must be emphasized that they do not measure the quality of the institution directly. The implicit assumption is that the most talented students are taught by first-class faculty, which adapts the content and requirements to their high abilities. Another implicit assumption is that of peer effects—outstanding students cause other students to improve their achievements (see Winston and Zimmerman, 2003). Less common quality metrics involve inputs (the ratio between the number of applicants and the number of students admitted, cost per student, faculty wages, and the number of lecturers relative to the number of students) and outputs (rating of publications by researchers in that institution, etc.). Zhang (2005), for example, discusses these metrics and the differences in how they affect wages.

Studies have found that, in terms of wage returns to education, the range between selective and other institutions is very wide, 0–20 percent, and usually does not exceed 10 percent outside the US. We review the findings by country since there are considerable differences in the structure of each country's higher education system (and, in particular, in the heterogeneity of the quality of institutions—the characteristic from which the selectivity in admissions is derived). However, it should be noted that the differences in results among and within countries may also stem from the different methodologies applied (see Chapter 4).

Most studies focus on the US. Brewer and Ehrenberg (1996) and Dale and Krueger (2002 and 2014) found that the quality of the institution has a minor effect, if any, on wages. Loury and Garman (1995), Thomas (2000), Hilmer and Cheslock (2001) and Hilmer (2001) found that having studied in a high-quality institution raises wages by 1–5 percent in the first years following graduation. Black et al. (2005) and Brand and Halaby (2006) found that graduates of the top quartile in terms of quality earn 4–7 percent more than graduates of the bottom quartile.

[8] The review is partially based on Zussman, et al. (2007) as well as on later studies.

10–20 percent higher wages were found by Brewer, et al. (1999), Thomas (2000), Black and Smith (2004), Thomas and Zhang (2005), Hoekstra (2009), Chen, et al. (2012) and Andrews, et al. (2016). Brand and Xie (2010) have shown that the highest return on the institution's quality is achieved by the students who are the least likely to graduate,[9] with the return decreasing for students from relatively strong backgrounds. Barrow and Malamud (2015) found that in the US, there is indeed a positive return on high-quality education, but it varies by population groups: It is higher among men than among women, and higher among Caucasians than among others.

Several studies have been conducted in the UK. Hussain, et al. (2009) found that high-quality institutions increase the return by 6 percent. However, McGuinness (2010) and Britton et al. (2016) show that the differences in return depend mainly on the academic subject at hand. Walker and Zhu (2018) have shown that male graduates of new universities earn 7 percent less than graduates of older universities, while women earn 5 percent less.

Few studies have been conducted in other countries. Milla (2017) found that in Canada, the return for graduates of elite institutions was 7–15 percent higher than those of graduates of other institutions. In Italy, Brunello and Cappellari (2008) found that the elasticity of expected wages (the probability of finding a job multiplied by the monthly wages) relative to the ratio between the number of faculty and the number of students in an institution (a measure of its quality) was 0.2, arising mostly from the probability of finding a job. Anelli (2016) used discontinuity in admissions to academic institutions to show that the annual wages of students who were slightly above the threshold for admission to an elite university in Milan were 52 percent higher than the wages of students who were slightly below the threshold and studied at another academic institution in the city. Furthermore, drop-out rates for the first group were lower, and they graduated six months earlier. Borgen (2014) found that in Norway, graduates of high-quality academic institutions earn 1–7 percent more than other graduates, and Lindahl and Regner (2005) showed that in Sweden, the gap is 4–8 percent. Several studies were conducted in Australia, most of which found no return gaps or found them to be lower than 5 percent (see, for example, Carroll et al., 2018). Ono (2004) researched Japan, showing that the wage premium for earning a bachelor's degree in a quality institution is about 5 percent among men who have been in the labor market for up to 5 years. Hastings, et al. (2013) studied Chile—using a method similar to the one used by Anelli (2016)—and found that the return varies according to academic subject: The return was high among graduates of academic professions whose admissions threshold was high, as well as among graduates of medicine, science and

[9] The odds are calculated according to the socioeconomic background and abilities.

social science programs. Bordon and Braga (2017) also studied Chile, finding that graduates of two of the most selective institutions enjoy a 6.5–8 percent return. In Colombia, Saavedra (2009) showed that among graduates of one of the elite institutions, employment prospects immediately after graduation are 16 percent higher.

Some studies have examined whether the quality of an institution also affects the rate of pay raise. Brand and Halaby (2006), Chevalier and Conlon (2003), Brunello and Cappellari (2008) and Bordon and Braga (2017), studied the US, UK, Italy and Chile, respectively, finding that even though graduates of elite institutions earn more, the gaps narrow or disappear altogether along with the seniority in the labor market. On the other hand, Brewer, et al. (1999) and Thomas and Zhang (2005) found that in the United States, the gaps widen with the increase in seniority, as did Borgen (2014) in Norway and MacLoed, et al. (2017) in Brazil. This widening gap may indicate that the high return on attending an elite institution is not only due to signaling to first-time employers after graduation, but also due to the fact that these institutions make a positive contribution to boosting work productivity levels.

Several studies have been conducted in Israel. Navon (2004) focused on Jews who graduated from universities in 1980–95 and served as salaried employees in 1995. He found considerable differences in wages by field of study and institution. It should be emphasized that this study did not control for the graduates' personal abilities. Shwed and Shavit (2006) based their study on a limited telephone survey and also controlled for matriculation grades. They found that the gross monthly wages of university and private college graduates were similar among university and private college graduates and one-third higher than those of public college graduates. Zussman, et al. (2007) relied on administrative data of scores for psychotechnical tests administered by the IDF for military service candidates, graduates of higher education institutions files and wage files. Focusing on 2000–02, they examined the monthly wages of people with bachelor’s degrees in their first job. Estimates using the Propensity Score Matching method (see footnote 22 below) revealed that university graduates earned about 20–30 percent more than college graduates in most professions; in business administration, their wages were about 19 percent lower than those of college graduates. Multivariate estimations (in the selection on observables approach) found that public (private) college graduates earned an average of 13 percent (about 7 percent) less than university graduates; in the first three years following graduation, the wages of university graduates rose 5 percent more quickly than those of college graduates.

Lang and Siniver (2011) relied on a limited survey and administrative data to examine graduates with similarly high abilities. They found that early on in their careers, graduates of

the Hebrew University earned higher wages than graduates of the College of Management, but the gap closed about 10 years later. According to the researchers, this finding indicates that the institution is used to signal employers about the graduates' abilities, but over time, employers discover the graduates' abilities on their own. Barzilay-Shaham and Yaish (2015) used the jobseekers' pool of a job placement firm to examine the variance of employment opportunities among engineers. They showed that after controlling for socio-demographic characteristics, but not controlling for personal abilities, university graduates and candidates who excelled in their studies were more likely to be summoned for a job interview. Ziv, et al. (2017) examined, among other things, the gaps in employment, wages and job satisfaction among law school graduates in higher education institutions. They found that while university graduates earn more on average than college graduates, college graduates are more likely to find work in their profession and feel more satisfied with their decision to study law. This study did not control for the graduates' personal abilities either.

Krill, et al. (2018) relied on the same database we used and made multivariate estimates in an effort to find the wage premium for the selectivity of an educational institution. They defined selectivity according to the average psychometric test score of the students in a specific department, in a particular institution, finding that for every 10 percent increase, the graduates' wages increased by an average of about 5 percent, with all other personal characteristics of the graduates being equal, including personal abilities. The return on selectivity varies according to the academic subject: In computer science and engineering, the premium on selectivity is high—for every 10 percent increase in the average psychometric score, the wages increase by 10 percent; but in biology, business administration and the humanities, no premium was found. The premium for selectivity also varies according to population group and socioeconomic background: It is higher among Jews than Arabs, and is higher among populations with high socioeconomic status than among middle and lower classes (the status was measured by parental income when the graduates were in their twenties).

3. Database, study population and descriptive statistics

(A) The database

The database relies on tracking all those born between 1978 and 1985. It includes the following data: Socioeconomic and demographic information from the Population Registry—gender, year of birth, country of birth of the individual and his/her parents, year of immigration, nationality/religion, number of siblings, the parents' marital status when the individual was 17, the individual's marital status and number of children and his/her place of residence at the age of 17; Education track in high school (State secular Jewish, State religious Jewish and ultra-Orthodox, Arab, Bedouin, Druze); Information about matriculation exam files—subject, number of study units and grade;[10] The psychometric score for each section of the test (quantitative thinking, verbal thinking and English);[11] Information about higher education—application and admission/rejection, academic subjects (major and minor), years of study and degrees; Information about employment and wages—employer-employee files from the Israel Tax Authority: Months worked and annual wages in each of the years between 2008 and 2015 (i.e., when the graduates were 23–37 years old); [12] and finally, selected data from the 1995 and 2008 population censuses.

Below we explain how we determined some of the variables. We divided the study's population into the following groups: Jews—native Israelis who studied in the State secular Jewish school system; Native Israelis who studied in the State religious Jewish school system, Individuals born in Europe or America[13] who studied in the State secular Jewish school system;, Individuals born in Europe or America[14]who studied in the State religious Jewish school system; individuals born in Asia or Africa (except for Jews of Ethiopian origin) who studied in the State Jewish school system (but are not ultra-Orthodox); Jews of Ethiopian origin[14] and ultra-Orthodox[15]; Muslim Arabs (non-Bedouins); Bedouins;[16] Christians; and Druze. Since the

[10] There are three proficiency levels in mathematics and English: High – 5 study units; intermediate – 4 study units; and basic – 3 study units. A similar system exists for other subjects.

[11] If an individual took the test more than once, we were given the higher score, which is the score that academic institutions take into consideration in the admissions process.

[12] We did not use the income files of the self-employed as their income depends on numerous factors that are not necessarily related to the quality of the education they had acquired.

[13] Including Oceania and South Africa.

[14] One whose parent/s immigrated from a Horn of Africa country (Ethiopia, Eritrea, Djibouti or Somalia) or from Sudan.

[15] Who studied in an "other" system in high school. Since a minor percentage of the students who studied in an "other" system are not ultra-Orthodox, we have omitted students with at least one sibling who has studied in the State secular Jewish school system.

[16] Anyone who studied in the Bedouin sector during high school and/or is Muslim in the Southern District and/or lived in one of the Bedouin settlements in the north of Israel: Avtin, Bueina-Nujidat, Bir al-Maksur, Basmat Tabun, Dameide, Zarzir, Khoald, Husseina, Hamam, Tuba-Zangariya, Kamana, Ka'biya-Tabash-Hajajra, Manshit Zbada, Su'ad (Hamriya), Salma, Aramsha, Rumat Heib, Shabli-Umm al-Ganam.

matriculation exams are not standardized and the grades obtained in different years are not comparable, we calculated the percentile of the students' grade in each subject and year, and weighted the percentiles by the number of units studied in each subject.[17] We also converted the psychometric test scores into percentiles. To obtain the monthly wages we took the annual wages from the employee-employer files and divided them by the actual number of months worked (as opposed to dividing by 12). To obtain the wages per working hour in 2008, we took the monthly wages per working month in 2008, divided it by the average number of weeks per month (about 4.3) and the number of weekly working hours reported by the individual in the 2008 census.

We defined the type of educational institution as follows: Elite universities (Tel Aviv University, the Hebrew University, the Technion and the Weizmann Institute of Science); Other Universities; Public (state-subsidized) Colleges; Private (non-subsidized) Colleges;[18] Colleges of Education. The classification of the universities into elite and other universities is consistent with their ratings in publications/cited papers (Kirsch, 2016) and international ratings (such as the Shanghai Rating and Times Rating).[19] We grouped the study subjects into 31 major subjects (see Table A-1 in the Appendix).

(B) The study population

Out of all those born in 1978–85 we omitted individuals who enrolled in undergraduate programs prior to age 17, soldier students, graduates of the Open University, medical students, and Ph.D. students (since the degree is taught only at universities, making it impossible to compare university graduates with college graduates). We were left with 158,373 individuals born in 1978–85, who attained an academic degree by 2014 and worked at least one month (after graduating) in the years 2008–15 (representing 67 percent of all graduates during these years). Thus, each graduate may receive a maximum of 8 observations in the annual wage equations.

Of all the possible wage observations, we omitted observations for years in which the individual studied for an additional undergraduate or graduate degree (and therefore may have earned their wages doing a part-time or temporary job that is incompatible with their education). We also omitted, for each year, 0.3 percent of the lowest wage observations (NIS 200–400 per

[17] In mathematics and English, we calculated the percentile for each number of units separately.
[18] Ariel University was added to the public colleges group, since it was recognized as a university only in 2012.
[19] Shanghai Rating: http://www.shanghairanking.com/ARWU2018.html;
The Times Rating: https://www.timeshighereducation.com/world-university-rankings/2018.

year) and 0.3 percent of the highest wage observations (approximately NIS 800,000 in 2015). We were left with a total of 692,469 observations of wage years.

(C) Descriptive statistics

Table A-2 in the Appendix presents descriptive statistics of graduates of higher education institutions by type of institution. As can be seen, native Israeli Jews have a relatively high representation in relation to their share of those born in 1978–85, while Muslim Arabs (especially Bedouin), ultra-Orthodox and Jews of Ethiopian origin have low representation. Arabs have high representation in colleges of education (three times their percentage of all graduates) but low representation in public and private colleges. A high proportion of private college graduates lived in the center of Israel during their childhood years. When focusing on the socioeconomic background of graduates and their personal abilities,[20] the institutions are ranked as follows: Elite universities, other universities and the three types of colleges. Among other university graduates and public and private college graduates, there are only very small gaps in socioeconomic backgrounds, but graduates of colleges of education lag behind. Among private college graduates, parental income from work is close to the corresponding figure among graduates of elite universities. The annual and monthly wages of elite university graduates are much higher at the age of 30 than those of the other graduates, and the wages of education college graduates are relatively low.

Table A-3 in the Appendix shows the correlation coefficients between key variables in the study. There is a high positive correlation (over 0.5) between the scores in the psychometric test sections, between the math matriculation level of 5 units of study and the quantitative score in the psychometric exam, and between the number of schooling years of the mother and father. There is a moderate positive correlation (0.3–0.5) between parental income, socioeconomic rating of the residential neighborhoods during childhood and parental education, as well as between the percentile of the average matriculation grade and the psychometric score.

[20] According to the matriculation grades and psychometric test scores.

4. Methodology

The study is designed to estimate the wage premium provided by higher education in the various types of institutions in Israel. The premium is affected by the admissions selection process for each institution, since talented students usually attend high-quality institutions. It is therefore difficult to distinguish between the return to students' abilities and the return to the human capital that the institution granted (the selectivity problem).

The literature presents three common methods for handling the selection process:[21]

(a) Multivariate estimation in the selection on observables approach (Rubin 1973): This method assumes that the effects of the unobservable factors (such as personal preferences and motivation) offset one another, and that the choice of institution explains many observable factors (such as background variables and personal abilities, especially the matriculation grades and psychometric test scores). Since we control for grades/scores, among other things, and they determine the chances of being accepted by institutions, the selectivity problem may be resolved. This is the main method used worldwide and in Israel to examine the wage premium of higher education institutions.[22]

(b) Two-stage estimation (TSLS): In the first stage, the probability of studying in a given type of institution is estimated given the personal characteristics (including abilities) and instrumental variable. In the second stage, a multivariate model is estimated that also includes the predicted probability of the first stage. As an instrumental variable, we used the geographical accessibility of the educational institution—i.e., the distance from the place of residence at age 17 to the type of institution that, at the time of enrollment, offered the subject of study ultimately chosen by the individual.[23] The accessibility of education gradually increased over the last two decades, though not evenly distributed geographically, which may allow for a high degree of statistical explanatory power for the first stage equation. However, accessibility seems to have little, if any, effect on the outcome variables examined in the second

[22] Additional, less common, methods include: Siblings/twins—who have similar innate abilities and childhood environment (see, for example, Behrman, 1996); the self-revelation model—reliance on similar applicants in the system of applications / admissions to higher education institutions (see, e.g., Dale and Krueger, 2002 and 2014 as well as Borgen, 2014). Milla (2017) reviews the methods for overcoming selectivity.

[22] In the past, the propensity score matching (PSM) was used—an estimation method similar to the multivariate approach under the selection on observables approach. In the first stage, the probability of studying in one type of institution is estimated for each graduate (the treatment). A graduate(s) of another institution is then found, taking the closest of them in terms of the predicted probability of attending an institution of the first type (control group). The effect of the treatment is equal to the average outcome variable among all graduates of the treatment and control groups. For more information see Dehejia and Wahba (1983). Researchers who used this method include Chevalier and Conlon (2003), Black and Smith (2004), Brand and Halaby (2006), Brand and Xie (2010) and Milla (2017). In Israel, it was used by Zussman et al. (2007).

[23] We assume that applicants first choose the subject of study and only then the academic institution.

stage equation (as detailed below), and thus the instrumental variable meets the exclusion restriction. Few studies have used this method; the exceptions are Long (2008) and Borgen (2014).

(c) Applying the fuzzy regression discontinuity method to admissions to academic departments: In this method, a comparison is drawn between the outcome variables of applicants from the two groups—those who slightly exceeded the admissions threshold for a given type of institution and those who were slightly lower than the threshold and therefore had to study the profession at another type of institution. In this case, we compare wages, and the comparison is drawn after controlling for other characteristics that may affect it. This method was used by Hoekstra (2009), Saavedra (2009), Anelli (2016) and Bordon and Braga (2017). It should be noted that Local Average Treatment Effect (LATE) estimates are obtained on individuals close to the admission threshold, and therefore conclusions cannot be drawn for all graduates of higher education institutions.

Studies show that when controlling for many variables including personal abilities—as we did here—a multivariate estimation often yields similar results to those used by other methods (e.g. Long, 2008; Borgen, 2014). Below is a breakdown of each of the estimation methods.

(a) Multivariate estimation under the selection on observables approach

We estimated the wage premium using equation (1):

$$logW_{it} = \alpha_0 + \alpha_1 M_i + \alpha_2 X_{it} + \alpha_3 E_i + \alpha_4 C_i + \alpha_5 F_i + \alpha_6 y_t + \varepsilon_i \quad (1)$$

where:

W_i – The annual/monthly/hourly wages of individual i for year t.

M_i – A set of dummy variables for the type of institution of higher education: Elite university, other university, private college; in some estimates, we also included graduates of colleges of education and added a dummy variable for them. The base group is a public College.

X_i – A set of socio-demographic characteristics of the individual: dummy variable for men, age, squared age, and dummy variables for the population groups (see Section 3a). Five dummy variables were also added to the residential district at age 17, with the Tel Aviv District serving as a baseline group. The residential district at age 17 reflects two effects: The environment in which the individual grew up and employment opportunities and wages available to them, as individuals have a tendency to continue to live in the same district in which they grew up.

E_i – A set of family background variables: The mother's and father's number of schooling years—in order to take into account that educated parents have, on average, higher levels of cognitive abilities; moreover, parental education may indicate the quality of the education they have given the individual in his/her childhood. Also included the following explanatory variables: Number of siblings, dummy variable for a married mother when the individual is 17 years old and the parents' income percentile (see Section 3a).

C_i – Set of personal cognitive abilities: The percentile of average matriculation grade, dummy for 5 or more units of mathematics, dummy for more than 30 units in the matriculation certificate, the percentile of the psychometric score.

F_i – Set of dummy variables for subjects of study. A dummy variable for a master's degree was also included.

y_t – A set of dummy variables for the wage years; these control for macroeconomic effects.

(b) Two-stage estimation

Access to higher education in Israel has been improving significantly since the mid-1990s, largely thanks to the "college revolution". Figure A-2 in the Appendix presents several key findings: (1) According to Part A(1), the greater the distance from a higher education institution, the smaller the odds of attending it; in addition, although the supply of institutions has grown over the years, the distances to them have not necessarily decreased since most of them are located in the center of Israel, while residents of Israel's geographic periphery have increased their share of the student population (see Part B); (2) In contrast, Part A(2) shows that distances to colleges, especially to the public ones, have greatly decreased over the years among a fixed student population;[24] (3) Part B shows that the establishment of public colleges in the periphery has greatly increased the share of periphery residents attending public colleges; while the greater number of private colleges, especially in the center of Israel, has boosted the share of residents of the center out of private college students; (4) In sum, after controlling for the candidates' characteristics, one finds that the probability of enrolling in college has skyrocketed over the years, while the probability of attending university has dropped sharply (Part C) due to the better access to colleges and only a moderate increase in the available number of places

[24] We took students who began their undergraduate studies in 2000, calculated the distance they traveled, and compared it to the distance they would have had to travel had they begun studying in 2010 (assuming that their place of residence and subject of study remained the same).

at universities, which have not caught up with the rapid increase in the number of students in higher education institutions.

Because the availability of the various institutions changed rapidly and differentially in terms of space and time, a two-step estimation (TSLS) can be made of the return on attending a particular type of institution, using an exogenous instrumental variable for this type of institution—i.e., the minimum distance (or similar measures, as explained below) between the locality in which graduate i resided before enrolling and the type k institutions which in the year of his/her enrollment t taught the subject he/she began to study (DIS_{ikt}).

The instrumental variable can be assumed to be exogenous for the following reasons: a) Establishment of institutions and/or academic departments involves a lengthy process of obtaining permits and preparations, and its timing is therefore random; b) Graduates' parents are unlikely to have moved in order to conform to their children's preferences for a particular educational institution, especially when the timing of their opening is unknown; c) The private colleges were established mainly in the center of Israel, where relatively well-off populations reside, while the public colleges were opened mainly in areas characterized by a population with weak socioeconomic background. While these factors are correlated with the graduates' wages, we control for them in the first and second stage equations (for example, the parents' income and education and district of residence before the studies began).

The first stage equation:

$$P_{ikt} = \alpha_0 + \sum_{k=1}^{4} \alpha_k \, DIS_{ikt} + \alpha_5 X_{it} + \alpha_6 E_i + \alpha_7 C_i + \alpha_8 F_i + \alpha_9 y_t + \varepsilon_{ik} \qquad (2)$$

where P_{ikt} is a dummy variable that receives the value 1 if graduate i enrolled at a k-type institution in year t (year of enrollment); otherwise it gets the value 0. The remaining variables are identical to those in Equation 1.[25] The equation is estimated separately for each of the following: Elite universities, other universities and private colleges.

In the second stage, the return on attending a particular type of institution is estimated (compared to attending a public college):

$$logW_{it} = \alpha_0 + \sum_{k=1}^{3} \alpha_k \hat{P}_{ikt} + \alpha_4 X_{it} + \alpha_5 E_i + \alpha_6 C_i + \alpha_7 F_i + \alpha_8 y_t + \varepsilon_{it} \qquad (3)$$

[25] Our study shows that the omission of the residential district at age 17, a variable correlated with the minimum distance to the type of institution of higher education, hardly changes the institutions' estimators in the second stage equation.

where $\hat{P}_{ikt}$ is the predicted probability that graduate i will study in a type k institution—this probability is derived from Equation 2 estimates of the first stage and each graduate's variable values—and the other variables are the same as those in Equation 1. The focus is on the estimators α_k (1,2,3=k) of the return on attending a type k institution.

Equation 3 can be restricted to academic subjects common to all types of institutions or estimated separately for selected academic subjects.

(c) Applying the fuzzy regression discontinuity method to academic-department admissions

This method takes advantage of the fact that admission to an academic department at a given institution is conditional on crossing the minimum entry threshold—called "Sechem" (total admissions score)—which is determined by the department and based on a formula that takes into account the average matriculation grade and/or psychometric score (and sometimes the scores in specific sections of the psychometric test). The underlying assumption is that there is a great deal of similarity between applicants whose total scores are slightly above or below the admissions threshold, so that if we compare the two groups in terms of outcome variables (including wages), we could learn about the return on enrolling in that particular department. The application of the method is based on the assumption that applicants cannot accurately adjust for their scores given their abilities (especially with the matriculation scores being set years before application). In addition, the threshold score may vary from year to year and from one department to another. There is therefore a degree of randomness in an applicant's chances of being slightly above or below the admittance threshold.

In Israel, applications are filed separately with each institution, so it is impossible to determine which institutions an applicant prefers. Nor do we know which formulas were used by the departments to calculate the total admissions score during the research years.[26] The information available to us includes departments to which undergraduate applicants applied, ranked by priority for each institution individually, whether the applicants were indeed accepted to their first-choice department, and what department they eventually enrolled in.

Given the information available to us, we chose to use the fuzzy regression discontinuity method. At first, we used binary estimation (Logit) to estimate, for each applicant, the probability of beginning to study in their first-choice department in the institution in which they enrolled and in the year of enrollment, based on the average matriculation grade and/or scores

[26] We attempted to obtain the information from several institutions (of different types), but almost always came up empty-handed.

in specific sections of the psychometric test (hereinafter, the ”Calculated Admissions Score”). We then estimated the admissions threshold for the department in the application year based on the Calculated Admissions Score and whether or not the applicant was accepted, using sensitivity and specificity analysis, a commonly accepted method in the literature. In this method, a group of possible admissions thresholds[27] are selected, each of which calculates two values: The applicants who are above the threshold out of the total number of applicants accepted (sensitivity) and candidates who are below it out of the total number of applicants rejected (specificity). An admissions threshold is selected with the maximum values.

In this context, it should be noted that the Fixed Point Procedure is another commonly used method in the literature.[28] In this method, the equation $P_i - \bar{P} = f(S_i) + \varepsilon_i$ is estimated, where P_i represents a dummy variable with the value 1 if applicant i is accepted to the department and the value 0 if rejected (with $\overline{\mathrm{P}}$ representing the average acceptance rate to the department), and f(·) representing a fourth-order polynomial of the Calculated Admissions Score; the root of the polynomial equals the estimated acceptance threshold. However, there are only negligible differences between the results generated by the two methods. Figure A-3 in the Appendix illustrates this using an electrical engineering department at one of the elite universities, but a similar result was obtained for other departments.

After selecting the admission threshold, one should keep all applicants for a (first-priority) department at a given type of institution and year and identifying those who also applied to the same department (first priority) at a public college. (We only examined applicants who have completed a degree in the department of their first priority, since there is no information as to whether applicants were accepted to lower-priority departments.) The candidates were divided into two groups: Those whose scores were higher than the Calculated Admissions Score for that type of institution[29] and those whose scores were lower than the threshold and enrolled in a public college. Below we shall estimate the following reduced-form equation:[30]

[27] The probability of being admitted to a department ranges from 0 to 1; we therefore chose all of the thresholds ranging from 0.05 to 0.95 using 0.05 increments.

[28] See Card et al. (2008). The authors used this method to estimate the proportion of minorities in the neighborhood crosses the threshold above which the "white" population accelerates its exit therefrom.

[29] As for applicants who applied to more than one institution of the same type (other than a public college), if they were accepted into one of the institutions, we shall use the Calculated Admissions Score for that institution. If they were not accepted, we will select the closest calculated admissions threshold to their Calculated Admissions Score.

[30] For a detailed description of the following equations estimated using the discontinuity method, see Anelli (2016).

$$logW_{it} = \alpha_0 + \alpha_1 A_{ijkt} + \alpha_2 f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_3 A_{ijkt} \times f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_4 X_{it} + \alpha_5 E_i + \alpha_6 C_i + \alpha_7 F_i + \alpha_8 y_t + \varepsilon_{it} \quad (4)$$

where A_{ijkt} (for Admission) is a dummy variable with the value 1 if the Calculated Admissions Score of applicant i to department j in a k-type institution in year t (S_{ijkt}) is higher than the Calculated Admissions Score (S_{jkt}^{cutoff}); otherwise it receives the value 0. f(·) represents a second-order polynomial. The other variables are the same as those in Equation 1, but we omitted the average matriculation grade and psychometric score since they are factored into the Calculated Admissions Score. We will estimate the equation three times, and in each, α_1 will represent the return on enrolling in a k-type institution compared to the return on enrolling in a public college.

It is preferable to limit the estimation to applicants whose Calculated Admissions Score is close to the department's admissions threshold, and it may be used separately for selected departments.

The reduced-form equation reveals the wage gaps between candidates whose Calculated Admissions Score has admitted them into a certain type of institution and applicants whose scores prevented them from being admitted. The reduced-form equation does not deal with two problems: A mismatch between acceptance according to the Calculated Admissions Score and the actual acceptance, and the fact that some of those admitted to a department choose not to enroll in it.

To deal with these problems, we will conduct a TSLS. The first stage equation is as follows:

$$P_{ijkt} = \alpha_0 + \alpha_1 A_{ijkt} + \alpha_2 f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_3 A_{ijkt} \times f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_4 X_{it} + \alpha_5 E_i + \alpha_6 C_i + \alpha_7 F_i + \alpha_8 y_t + \varepsilon_{ijkt} \quad (5)$$

where P_{ijkt} is a dummy variable which receives the value 1 if applicant i started studying in department j at a k-type institution (non-public college) in year t, and gets the value 0 if he/she enrolled in the same department in a public college (we shall therefore make estimations for each of the three types of institutions that are not public colleges). The remaining variables are identical to those in Equation 4. In this case, too, the estimation will only be made for applicants who have graduated with a bachelor's degree from the department they indicated as being their first priority.

In the second stage, the return on attending a particular type of institution is estimated (compared to attending a public college):

$$logW_{it} = \alpha_0 + \alpha_1 \widehat{P}_{ijkt} + \alpha_2 f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_3 A_{ijkt} \times f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_4 X_{it} + \alpha_5 E_i + \alpha_6 C_i + \alpha_7 F_i + \alpha_8 y_t + \varepsilon_{it} \quad (6)$$

where $\hat{P}_{ijkt}$ is the predicted probability of graduate i enrolling in department j at a k-type institution (1,2,3=k) compared to his/her chances of enrolling in a public college (obtained from Equation 5), the other variables being identical to the ones in Equation 5. We will estimate Equation 6 three times, and each time, α_1 will represent the return on enrolling in a k-type institution compared to the return on enrolling in a public college.

5. Results of the Estimations

This section describes the results of the estimations of the wage premium on higher education acquired in the different types of institutions. In subsection (a), we discuss the annual wages in 2008–15, and in subsection (b), the hourly wage. In subsection (a), we present both the findings from the multivariate estimations and the findings from other methods that can be applied only to people with undergraduate degrees.

(a) The return by type of institution of higher education in terms of *annual* wages

Multivariate estimations

We used the OLS method to estimate gross annual wages as a function of the institution type and additional variables. In all models, we control for basic variables: Gender, age, district of residence during childhood, academic department, academic degree, and the year in which the estimated wages were earned. Models 1–4 differ in the controlled variables: Model 1 only controls for the basic variables; in Model 2, the population group was added; in Model 3, the household's past and present background characteristics were added; and in Model 4, personal abilities were added. Table 1 outlines the results.

Models 1–3 indicate that graduates of elite universities earn about 22 percent more than public college graduates, graduates of "other universities" earn about 17 percent more, and graduates of private colleges about 8 percent more. Adding population groups (Model 2) and household background characteristics (Model 3) hardly changes the institution type estimates. However, after controlling for personal abilities (Model 4), the gap in favor of the elite universities is greatly diminished: it stands at about 11 percent, similar to the gap in favor of other universities; the difference between types of universities is non-significant. This finding indicates that graduates of elite universities have high abilities (Table A-2 in the Appendix), which are positively correlated with wages. The gap between universities and private colleges

remains significant,[31] and the difference between private and public colleges remains stable, at about 7 percent. When limiting the wage equations to recent years (2012–15), similar results are obtained (Model 5), and the same is true for estimations focusing on the average annual wages in those years (Model 6).[32,33]

Before examining the heterogeneity of the return, we will elaborate on the controlled variables in Model 4. All else being equal, the annual wages of graduates with master's degrees is about 17 percent higher than those with only an undergraduate degree.[34] Men's wages are about 26 percent higher than women's, and wages increase with age (with job seniority) at a declining rate. Jews who immigrated from Europe or America and who studied in the State secular Jewish school system earn a little more than native Israeli Jews who studied in the State secular Jewish school system (the baseline population). Immigrants from Asia and Africa (with the exception of Jews of Ethiopian origin) earn the same as the baseline population. Graduates of the State religious Jewish education system who were born in Israel or immigrated from Europe or America, as well as the ultra-Orthodox, earn less than the baseline population, and Jews of Ethiopian origin earn even less. Arabs from all population groups earn less than the baseline population. The Bedouin, however, are different: Their wages far exceed those of the baseline population, since only few of them graduate from academic institutions and they appear to possess high unobservable abilities. The wages of graduates who lived in Tel Aviv

[31] We also estimated Model 4 after splitting the dummy variable for the private colleges: A dummy for the four largest colleges (approximately 83 percent of the graduates during the study period) and a dummy for the other, much smaller, institutions. It appears that among the graduates of the largest colleges, the annual wages were about 8 percent higher than those of public college graduates, while the wages of graduates of the smaller colleges were about 2 percent lower.

[32] Some institutions do not require undergraduate applicants to submit their psychometric test scores, which is common in colleges. We therefore re-estimated Model 4 for graduates who had at least matriculation exam grades, without controlling for the psychometric test scores. As expected, universities have higher estimators (about 2 percentage points), since their graduates have, on average, higher abilities, which is reflected in their wages; the private colleges estimator remained virtually unchanged. We obtained similar results to those in the table when we restricted Model 4 to applicants who met the universities' threshold requirements (eligibility for a matriculation certificate + a passing grade in mathematics (3 study units [basic level], at a minimum) + a passing grade in English (4 study units [intermediate level], at a minimum) + passing grade in another subject [other than in math and English] (4 study units [intermediate level], at a minimum).

[33] It may be argued that the multivariate estimation does not adequately control for the selectivity in admissions to higher education institutions, especially given the fact that there are considerable differences in the personal abilities of the applicants to the different types of institutions. We therefore repeated the estimation presented in Table 1 (Column 4) and restricted it to graduates whose probability of enrolling in each of type of institution was found in the common support using the PSM method. The estimators of the types of institutions are similar to those obtained above.

[34] When omitting the dummy variable for graduate degree from the estimations, as Krill et al. (2018) did, one finds that among graduates of elite universities, the annual wages are 15.3 percent higher than the wages among graduates of public colleges, 13.3 percent higher among graduates of other universities and 6.5 percent higher among graduates of private colleges. The sharp rise in the return on enrolling in elite universities should come as no surprise, since a relatively high proportion of people with undergraduate degrees go on to enroll in a master's program, a degree which most often provides a return in terms of wages.

and the Central Districts during their youth earn 3–7 percent more than graduates who lived in other parts of Israel (not shown), partly because of the better employment and wage opportunities and the fact that people tend to continue living in the same area they did when growing up. Parents' education has little effect on their children's wages, probably because they are graduates of higher education institutions to begin with. For every 10 percent increase in the parental income percentile, the graduates' wages increase by 1 percent,[35] and when graduates are raised in a household with two parents, the wages increase by about 2 percent. As for the effect of personal abilities on wages—for every additional 10 percentage points in the average matriculation grade or psychometric test score, the wages increase by approximately 2 percent. The more study units in the matriculation diploma, the higher the wages; 5 units of math is correlated with higher wages by about 9 percent—slightly more than the value found by Kimhi and Horowitz (2015).[36]

Let us now examine the returns by **gender** and **nationality** separately. The estimations allow comparisons to be made within each group but not between the groups, and their results are presented in Table 2. However, when the estimations pertain to all graduates and include interaction variables between the type of institution and gender/nationality, comparisons can be drawn both within each gender/nationality and between the groups; the results of these estimations are presented in Figure 1. In general, the table and figure show that the return hierarchy for the types of institutions is similar to that presented in Table 1. With the exception of the elite universities, all types of institutions provide higher returns for men and for Jews. Arabs who attended elite universities enjoy returns that are higher than both Arabs who attended other institutions and Jews who attended elite universities. This may be due to the fact that only a very small percentage of Arabs graduate from elite universities, and may have unobservable

[35] Heller (2018) examined people born in 1975 and found that for every 10 percent increase in their parents' income (whether salaried employees or self-employed) when they were 11-20-year-old, their own income increased by 2.5 percent (when they were 35-39 years old). We are studying graduates of higher education institutions, so it is no surprise to find that the elasticity is much lower.

[36] To reflect possible peer effects on wages, we estimated Model 4 after adding to the explanatory variables the average percentile of psychometric test score among first-year students in the department in which the individual is enrolled and on the year in which he/she first enrolled in it. It appears that the estimators of the types of institutions remained almost unchanged, as did the estimator of the individual's psychometric test score percentile. In other words, the return cannot be attributed to the peer effects. The average estimator of the psychometric test score percentile in a department is not significant; this is probably due to the fact that the ranking of the average percentile by type of institution is maintained in most subjects of study: Elite universities are at the top of the list, with the other universities, private colleges and public colleges lagging far behind. We also made an estimate from which we omitted the dummy variables for the types of institutions and substituted them with the log of average percentile of the psychometric test score in the department. The relative wage elasticity was found to be approximately 0.1. (The wage elasticity relative to the average psychometric score in a department is approximately 0.4, similar to the value attained by Krill et al. [2018].)

characteristics rewarded by the job market, or employers may regard their very graduation from the leading institutions as a reliable indication of their high abilities. In private colleges, Arabs enjoy a very low return compared to Arabs in other institutions and Jews in private colleges, probably because a relatively high proportion of Arabs study in small private colleges, and as stated, the return on enrolling in them is very low (see footnote 31 above). Figure A-4 in the Appendix shows the return by type of institution separately for each population group, and indicates that the rate of return is very heterogeneous: There is a different hierarchy in each population group.

Figure 2 shows the differences in return on each type of institution by **parental income**. In general, the hierarchy of the institutions remains unchanged, and the return increases when moving from the lowest income quartile to the two middle quartiles, and then stabilizes. Private colleges, however, are the exception to the rule: The return on them increases even when moving to the upper income quartile, where it even exceeds the return on universities. Some private college graduates may have parents who can help them successfully integrate into the labor market, such as through personal connections—which is more essential in the subjects most commonly studied in private colleges.

Figure 3 outlines the return on the types of institutions by **subject**, and is highly heterogeneous. However, when examining the study subjects that are closely related to the labor market, one finds that when it comes to engineering and computer science, university graduates enjoy relatively high wages, as do para-medical professions and law. In economics, graduates of private colleges have a distinct advantage, and in business administration, a slight advantage for graduates of public colleges.[37]

Multivariate estimations using the selection on observables method deal with the selectivity issue only partially, since naturally, they do not control for unobservable variables that are correlated with the chances of being accepted by a certain type of institution or with the wages. Therefore, we also made estimations that focused on siblings, adding family fixed effects (FE) to the explanatory variables, in order to control for the unobservable characteristics shared by siblings, such as childhood environment, and cognitive and other abilities. Table 3 shows the

[37] Employees with a certain seniority in the labor market often enroll in higher education programs (for example, business administration) while continuing to work, in order to improve their attractiveness in the labor market, a phenomenon that is probably more common in colleges than in universities. These graduates earn more than those who enrolled in higher education institutions immediately after graduating from high school or after completing their military service or "national service". Therefore, we also made estimations that were limited to graduates who completed their undergraduate degree until age 30 or completed their graduate degree until age 32, i.e., people among whom the phenomenon is rare. The estimators of the types of institutions remained almost unchanged (including when estimating for business administration graduates only).

estimations focused on the siblings (Models 2–4) alongside the main estimation (Model 1).The results show that adding family FE almost doubles the model's explanatory capability, and this finding indicates that the unobservable characteristics do indeed have a great effect on the wages. Model 2 included all siblings who participated in the primary estimation. It can be seen that without family FE, the results obtained are similar to those obtained in the primary estimation. Adding family FE does not affect the estimates of return to education acquired at universities, but reduces by half the estimate of return to education acquired at private colleges. It should be noted that Lindahl and Regner (2005), who studied Sweden, found that the differences in return estimates by type of institution are greatly narrowed when estimations included family FE. Model 3 only includes siblings who studied in institutions of different types, and the results are similar to those of Model 2. The resulting decline in private colleges following the addition of family FE can be explained in part by the fact that graduates often have parents who can help them successfully integrate into the labor market (see also Figure 2 above regarding graduates with well-off parents).[38]

So far, we have made the estimations without directly taking into account two factors: (a) the number of years that have elapsed since graduation, and (b) the graduation year.[39] Controlling for factor (a) may teach us whether the wage gaps between graduates of different types of institutions stem from the signaling to employers regarding the average quality that characterizes graduates as soon as they enter the job market, and if, after spending several years in the labor market, the gaps change because employers discover the quality of the education acquired at the different institutions. Controlling for factor (b) can teach us if, over the years, there has been a change in the level of wages among graduates of the different types of institutions—for example, the quality of new colleges may have improved due to their accumulated experience. Figure A-5 in the Appendix shows that the return gaps between types of institutions remain more or less the same in the first decade after graduation. A similar picture emerges when examining the return gaps by year of graduation (Figure A-6 in the Appendix). We also examined the development of the gaps over a given number of years after graduation. Figure A-7 in the Appendix shows that, while the estimates are not always stable, in general, the return gaps between the types of institutions remain similar over the years, with the

[38] We also examined the possibility of estimating Model 3 for siblings who studied in different types of institutions but in the same department. This estimation is problematic due to the uniqueness of the participating population, as well as the difficulty in obtaining statistically significant estimators due to the considerably less degrees of freedom (with the addition of FE).

[39] We control for the two factors, partially and indirectly, through the age and the wage year.

exception of an increase among graduates of other universities in the 3-year period following graduation.

So far, we have compared the annual wages of graduates of different types of institutions with the wages of graduates of the public colleges; as a result, we could not draw any conclusions about the return on enrollment in these colleges. Therefore, Figure A-8 in the Appendix shows the annual wages of individuals who graduated with a bachelor's degree in each of the institutions (as opposed to by type of institution), by subject of study, compared to the wages earned by those with a high school diploma only. The figure reflects two key findings: (1) There is much variance among institutions of the same type in terms of the annual return attained by graduates of certain departments, which is especially true of public colleges; (2) If one enrolls in a public college for a degree that has affinity to the labor market, he/she will attain a relatively high annual wage premium compared with the wages earned by people with a high school diploma: Approximately 30 percent in social sciences (social work and economics) and business administration, approximately 60 percent in engineering, and over 80 percent in computer science. When the baseline group is limited to those with a matriculation certificate in the non-vocational track, it is found that the returns for public college graduates are slightly higher than the above (not shown).

Finally, Figure A-9 in the Appendix shows the estimates (from Table 1, Model 4) of the dummy variables for the study subjects compared to Economics, with the other controlled variables being equal and regardless of the type of institution. The figure shows the following wage hierarchy: Computer science and electrical engineering graduates earn 40–50 percent more than economics graduates; graduates of other engineering professions earn 15–30 percent more; social science graduates earn less than economics graduates; and graduates of the humanities are at the bottom of the hierarchy. The figure also shows that the hierarchy remains intact when it comes to gross annual wages, i.e., without controlling for any characteristics, and that the wage gaps in this case are considerably wider. This finding suggests that, as expected, the labor market rewards personal competence and abilities, among other things.

Table 1. Factors Explaining the Annual Wage Premium on Higher Education

	2008—2015				2012—2015	
					Annual data	Multi-year average
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Elite universities[1]	0.216***	0.218***	0.218***	0.113***	0.119***	0.127***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Other universities[1]	0.163***	0.169***	0.167***	0.108***	0.118***	0.118***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Private colleges[1]	0.086***	0.083***	0.079***	0.068***	0.062***	0.063***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Master's degree	0.187***	0.184***	0.182***	0.171***	0.159***	0.165***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Male	0.254***	0.256***	0.257***	0.261***	0.301***	0.309***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Age	0.220***	0.204***	0.193***	0.204***	0.214***	0.230***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.014)	(0.028)
Age squared	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Jewish:[2]						
Native Israeli who studied in the State religious Jewish school system		-0.059***	-0.054***	-0.064***	-0.068***	-0.071***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.007)
Europe- or America-born individual who studied in the State secular Jewish school system		0.010*	0.008	0.025***	0.029***	0.025***
		(0.005)	(0.006)	(0.006)	(0.006)	(0.007)
Europe- or America-born individual who studied in the State religious Jewish school system		-0.117***	-0.112***	-0.109***	-0.113***	-0.104***
		(0.016)	(0.016)	(0.016)	(0.017)	(0.018)
Asia- or Africa- born individual (excl. Ethiopia)		-0.012	-0.009	0.006	0.001	-0.010
		-0.024	(0.024)	(0.023)	(0.024)	(0.027)
Jew of Ethiopian origin[3]		-0.253***	-0.230***	-0.181***	-0.183***	-0.145***
		(0.019)	(0.020)	(0.020)	(0.022)	(0.023)
Ultra-Orthodox		-0.117***	-0.103***	-0.108***	-0.108***	-0.103***
		(0.031)	(0.031)	(0.031)	(0.033)	(0.036)
Arab:[2]						
Muslim (non-Bedouin)		-0.095***	-0.081***	-0.085***	-0.061***	-0.068***
		(0.010)	(0.010)	(0.011)	(0.012)	(0.013)
Bedouin		0.113***	0.148***	0.160***	0.137***	0.132***
		(0.023)	(0.025)	(0.025)	(0.028)	(0.031)
Christian		-0.055***	-0.052***	-0.063***	-0.065***	-0.066***
		(0.013)	(0.013)	(0.013)	(0.015)	(0.017)
Druze[4]		-0.139***	-0.135***	-0.124***	-0.077***	-0.098***
		(0.021)	(0.022)	(0.022)	(0.023)	(0.026)
District of residence at age 17	V	V	V	V	V	V
No. of schooling years – mother			0.001	-0.001*	-0.002*	-0.001
			(0.001)	(0.001)	(0.001)	(0.001)
No. of schooling years – father			-0.002***	-0.004***	-0.005***	-0.005***
			(0.001)	(0.001)	(0.001)	(0.001)
No. of siblings			-0.002	-0.001	-0.000	-0.002
			(0.001)	(0.001)	(0.001)	(0.002)
Mother was married when individual was 17			0.025***	0.022***	0.024***	0.024***
			(0.006)	(0.006)	(0.007)	(0.007)

Parents' income percentile[5]			0.001***	0.001***	0.001***	0.001***
			(0.000)	(0.000)	(0.000)	(0.000)
Percentile of average matriculation grade[6]				0.002***	0.002***	0.002***
				(0.000)	(0.000)	(0.000)
Advanced mathematics (5 units)				0.090***	0.086***	0.093***
				(0.005)	(0.005)	(0.005)
More than 30 study units in high school diploma				0.026***	0.025***	0.028***
				(0.005)	(0.005)	(0.006)
Percentile of psychometric score				0.002***	0.002***	0.002***
				(0.000)	(0.000)	(0.000)
Study subject	V	V	V	V	V	V
Married[7]			0.119***	0.127***	0.115***	0.106***
			(0.004)	(0.004)	(0.005)	(0.005)
No. of children aged 0–1[7]			-0.175***	-0.176***	-0.160***	-0.032***
			(0.003)	(0.003)	(0.004)	(0.009)
No. of children aged 1–3[7]			-0.027***	-0.027***	-0.000	-0.022***
			(0.003)	(0.002)	(0.003)	(0.004)
No. of children aged 3–6[7]			0.002	0.002	0.018***	0.021***
			(0.003)	(0.002)	(0.003)	(0.004)
No. of children aged 6–13[7]			-0.014***	-0.014***	-0.004	-0.002
			(0.003)	(0.003)	(0.004)	(0.004)
No. of children aged 13–18[7]			0.001	0.001	-0.002	-0.015
			(0.012)	(0.012)	(0.013)	(0.017)
Wage year	V	V	V	V	V	V
No. of observations	677,870	677,870	677,870	677,870	419,610	107,331
Adjusted R^2	0.242	0.244	0.250	0.257	0.242	0.314

Source: Based on Central Bureau of Statistics data processed by the authors.
*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (standardized at the individual level) appear in parentheses.
(1) Baseline group: The public colleges.
(2) Baseline group: Jews and other native Israelis who studied in the State secular Jewish school system.
(3) He/she or at least one of their parents immigrated from a Horn of Africa country or from Sudan.
(4) And Circassians.
(5) The parents' gross annual income received as salaried employees or self-employed when their child (the graduate of the institute of higher education) was 24. The percentile was calculated according to the father's age group, separately for each year, in order to take into account the income development over the life cycle.
(6) The average percentile of grades in subjects for each test's year weighted according to the number of study units in each subject.
(7) In the wage year.

Table 2. Annual Wage Premium on Higher Education by Gender and Nationality, 2008–15

	Total[1]	Men	Women	Jews	Arabs
Elite universities[2]	0.113***	***0.136	***0.105	***0.107	***0.103
	(0.006)	(0.009)	(0.008)	(0.006)	(0.024)
Other universities[2]	0.108***	***0.126	***0.107	***0.111	*0.032
	(0.005)	(0.007)	(0.006)	(0.005)	(0.022)
Private colleges[2]	0.068***	***0.049	***0.090	***0.067	*0.030-
	(0.006)	(0.009)	(0.008)	(0.006)	(0.029)
The controlled variables[3]	V	V	V	V	V
No. of observations	677,870	268,471	409,399	619,548	58,322
Adjusted R^2	0.242	0.268	0.185	0.257	0.278

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

(1) All graduates of higher education institutions. Same as the results in Table 1, Model 4.

(2) Baseline group: The public colleges.

(3) The controlled variables included in Table 1, Model 4.

Table 3. Annual Wage Premium on Higher Education Among Siblings, 2008–15

	Total[1]	Siblings only			
		Total		Studied in different types of institutions	
	Model 1	Model 2		Model 3	
		Without FE	With FE	Without FE	With FE
Elite universities[2]	0.113***	0.125***	0.128***	0.137***	0.133***
	(0.006)	(0.010)	(0.013)	(0.013)	(0.014)
Other universities[2]	0.108***	0.118***	0.105***	0.120***	0.115***
	(0.005)	(0.008)	(0.011)	(0.011)	(0.012)
Private colleges[2]	0.068***	0.080***	0.042***	0.079***	0.058***
	(0.006)	(0.010)	(0.014)	(0.014)	(0.015)
The controlled variables[3]	V	V	V	V	V
No. of observations	677,870	262,256	262,256	130,238	130,238
Adjusted R^2	0.257	0.263	0.507	0.260	0.469

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

(1) Including graduates without siblings who graduated from these institutions. Same as the results in Table 1, Model 4.

(2) Baseline group: The public colleges.

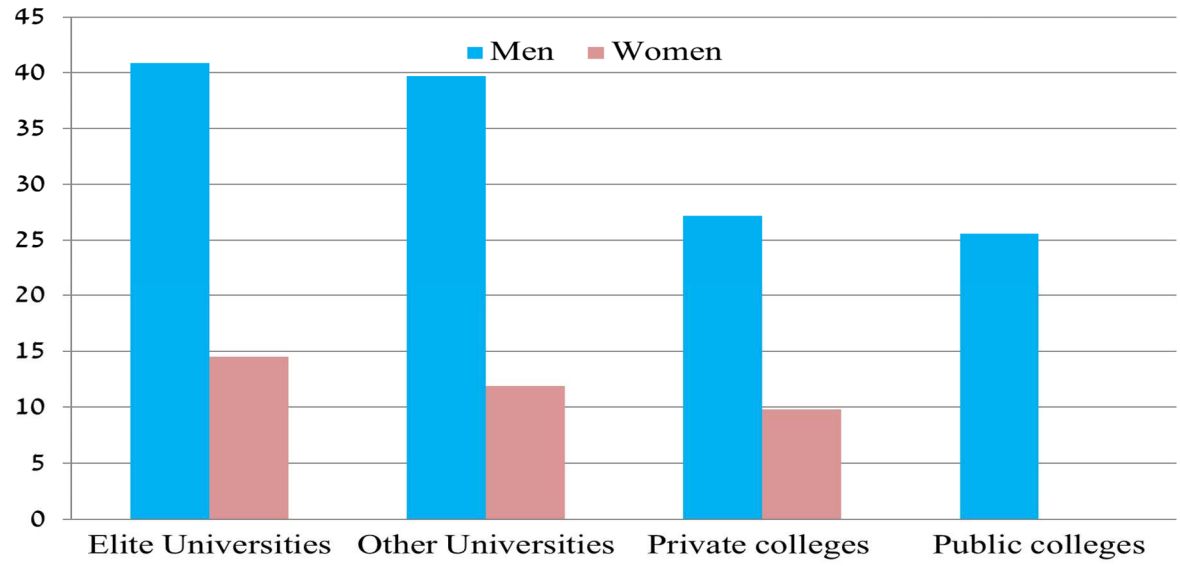
(3) The controlled variables included in Table 1, Model 4.

Figure 1

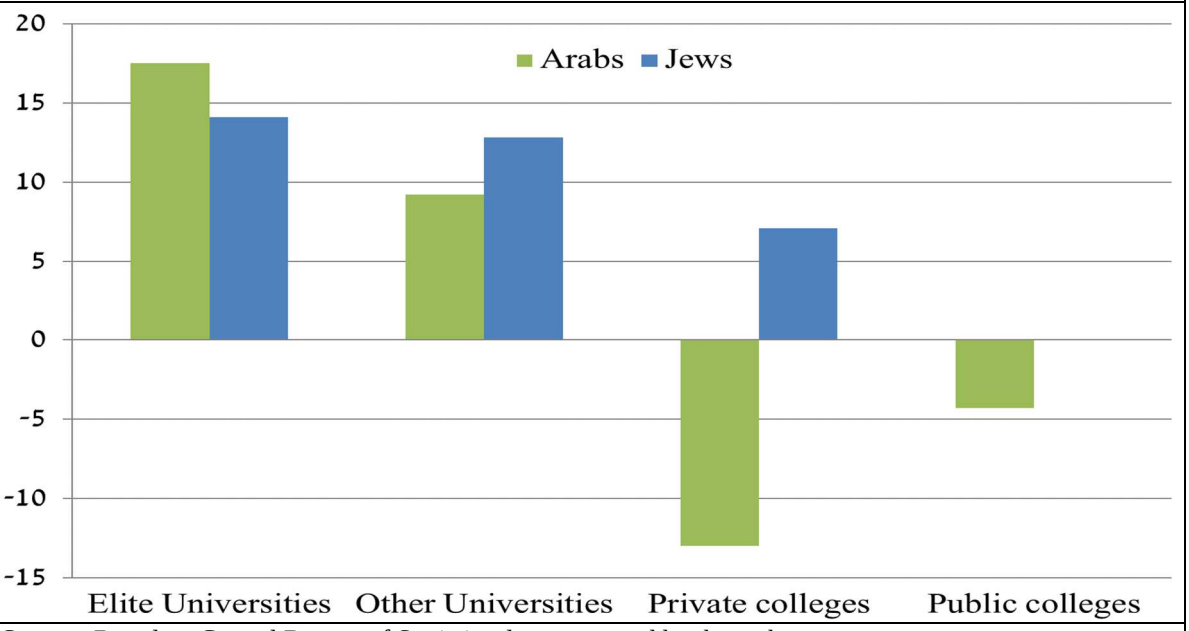
Annual Wage Premium on Higher Education by Gender and Nationality, 2008–15

(percent)

a. By gender[1]



b. By nationality[2]



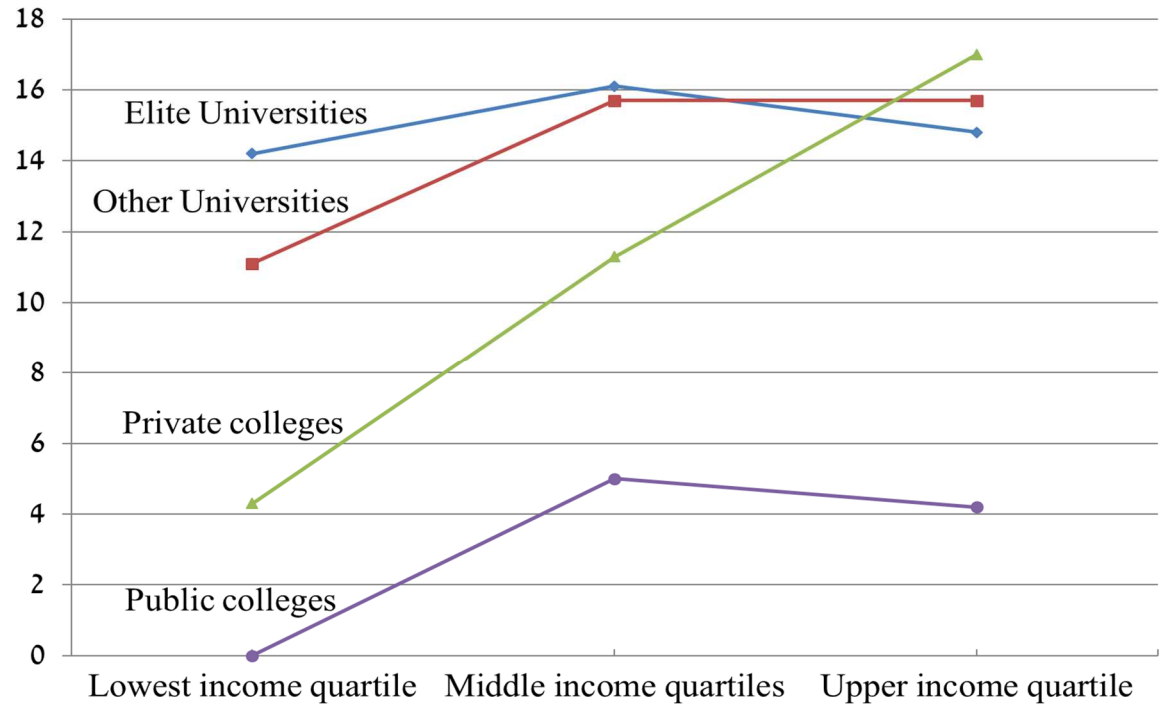
Source: Based on Central Bureau of Statistics data processed by the authors.

(1) Based on estimates of the variables for interaction between the gender and dummy variable for the type of institution. These variables were added to the controlled variables in the estimation such as the one shown in Table 1, Model 4.
Baseline group: Female graduates of public colleges.

(2) Based on estimates of the variables for the interaction between the nationality and the dummy variable for the type of institution. These variables were added to the controlled variables in the estimation such as the one shown in Table 1, Model 4.
Baseline group: Jewish graduates of public colleges.

Figure 2

Annual Wage Premium on Higher Education by Parental Income[1], 2008–15 (percent)



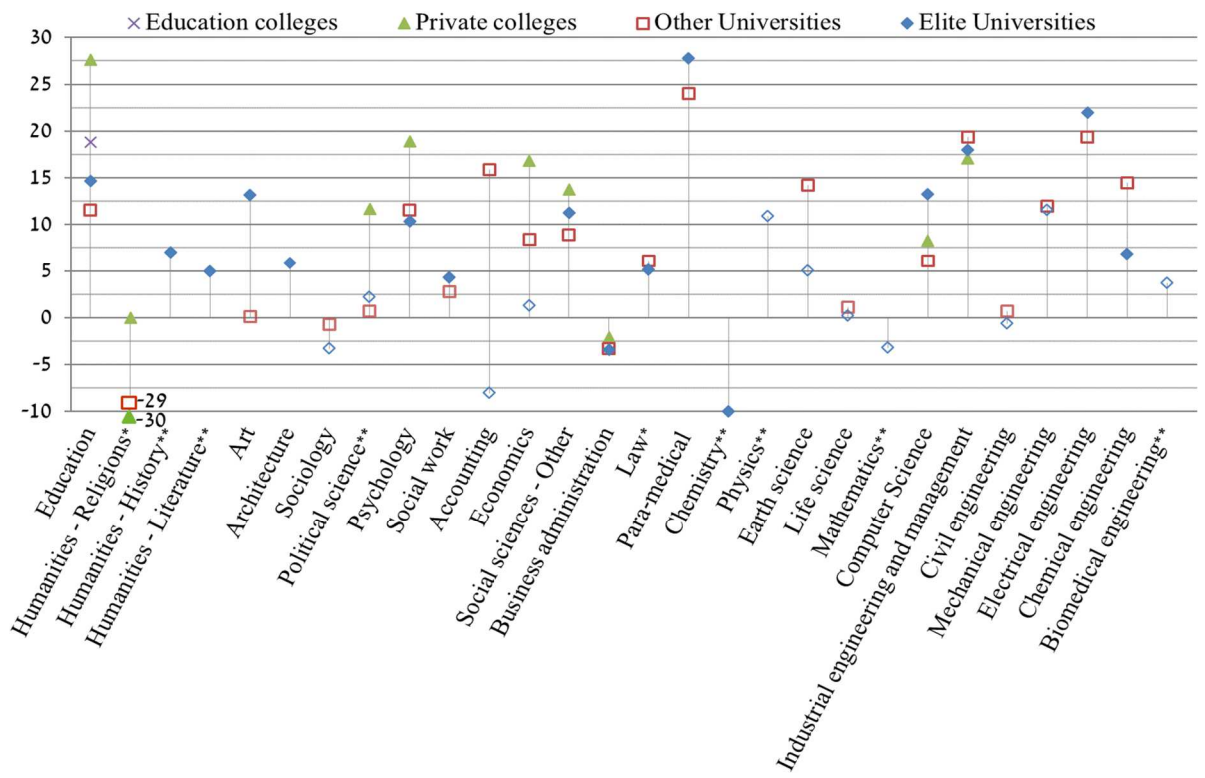
Source: Based on Central Bureau of Statistics data processed by the authors.

(1) Based on the variables for interaction between the dummy variable for the type of institution and the dummy variable for the gross annual income quartile of the parents as salaried employees or self-employed when their children (graduates of the institution) turned 24. These variables were added to the controlled variables in the estimation such as the one shown in Table 1, Model 4.
The baseline group: Graduates of public colleges whose parents' income is in the lowest quartile.

Figure 3

Annual Wage Premium on Higher Education by Subject,[1] 2008–15 (percent)

Based on multivariate estimations[2]



Source: Based on Central Bureau of Statistics data processed by the authors.
* Baseline group: Private colleges, ** Baseline group: Other universities.
A pale square and empty diamond and triangle represent a non-significant 10 percent estimate.
(1) Major subject. The figure shows subjects that were taught in at least two types of institutions, and in which type at least 30 students graduated each year with a bachelor's or master's degree.
(2) Based on the estimates of the dummy variables for the type of institution, such as the one shown in Table 1, Model 4. The estimations were made separately for each subject.

We also estimated the *monthly* return to higher education acquired in the different types of institutions.[40] We obtained the same hierarchy as the annual return hierarchy, even when limiting the estimates to siblings. The gaps between the types of institutions are more or less stable in the first decade after graduation as well as by year of graduation, and are very similar to the annual wage gaps presented in Figures A-7 and A-8 in the Appendix. The differences that arise in the monthly return after a certain number of years have elapsed since graduation are similar to the differences in the annual return shown in Figure A-7 in the Appendix. The similarity between the monthly and annual returns stems from the fact that after controlling for personal characteristics, there are on average no real differences in the number of annual working months between the graduates of the different types of institutions.

[40] The results are available upon request from the authors.

Two-stage estimations with an instrumental variable

In the first stage, we estimate the probability of enrolling in a particular type of institution as a function of the availability of that type of institution and of other variables (Equation 2 above). We defined availability in several ways: (1) The minimum distance between the locality in which the student resided at age 17 and localities with institutions of a given type;[41] (2) The log distance; (3) A dummy variable that receives the value 1 if the distance to a given type of institution does not exceed 50 kilometers and the value 0 otherwise;[42] (4) The number of institutions to which the distance is up to 50 kilometers; (5) The number of first-year students in a department in which the student is enrolled in a given type of institution, provided that the institutions are not more than 50 kilometers away from his/her place of residence. The estimations were made only among those with bachelor's degrees, as more than two-fifths of those with master's degrees graduated from a different type of institution.

The results of the first stage are presented in Table A-4 in the Appendix. It shows that the availability variables are highly significant and are almost always in the right direction: The probability of enrolling in a given type of institution diminishes the less accessible it is and the more accessible other types of institutions are. Table A-5 in the Appendix refers to enrollment in two types of institutions, and shows that the most common combinations are as follows: Elite universities with other universities, and public colleges with other universities. The size of the availability estimates in Table A-4 is generally consistent with the findings regarding enrollment: If there is a high incidence of enrollment for one type of institution as well as for another type of institution, the availability of the second one will be given a relatively high estimate (in absolute value) in the first stage equation of the probability of enrollment in the first one. (For example, an "other university" being available creates a relatively strong negative effect on the chances of enrolling in an elite university).

Table A-4 also shows that the explanatory power of the first stage equations does not change much when the definition of availability is altered (and is relatively low when it comes to "other universities"). When defining availability in terms of the log distance, only one estimate is in the wrong direction—an expected result given that the chance of enrollment diminishes along with the distance (Figure A-2 in the Appendix). Therefore, the deviance of

[41] If the subject was not offered by an institution when the student first enrolled in that institution, we added a thousand kilometers to the distance between the student's place of residence at 17 and the locality of the institution.

[42] We chose 50 km because, at a greater distance, the probability of enrolling in an institution of a given type greatly declines (see Figure A-2 [Part A] in the Appendix), and this appears to be partly due to commuting considerations. Reducing the distance to 40 or 30 km greatly diminishes the explanatory power of the first stage equation.

the availability variables (which corresponds to the F value in the Wald test in the first stage OLS estimates) also receives the highest value when using the log distance. As a result, most second stage estimations will rely on the first stage equations in which the log distance serves as an instrumental variable.[43]

Table 4 outlines the results of the second stage for the availability variables included in the first stage.[44] It shows that students who completed their undergraduate degrees at an elite university earn up to 4 percent more than graduates of public colleges, graduates of "other universities" earn about 16–24 percent more, and graduates of private colleges, about 10–14 percent more. It should be emphasized that in the first stage equation, the availability variables of the private colleges receive a relatively low deviance value (Table A-4 in the Appendix), so their estimate in the second phase equation should be treated with caution.

Table 5 compares the results obtained by the two-stage estimations with the results obtained by the multivariate estimations, only among those with bachelor's degrees. The left-hand part shows that the differences are mainly related to the relative return on higher education acquired in the elite universities: according to the two-stage estimation, the relative return is about 3 percent, and according to the multivariate estimate, about 12 percent. Graduates of "other universities" receive a higher return in the two-stage estimation than in the multivariate estimation (about 16 percent versus about 11 percent, respectively). Limiting the multivariate estimation to those with bachelor's degrees indicates that the estimates of the types of institutions remain virtually unchanged compared to the estimates obtained for graduates with bachelor's and masters' degrees (Table 1, Model 4).

Graduates of study programs that are available only at universities (e.g., humanities and some social science subjects) receive a low return on their education, and comprising a relatively high percentage of university graduates. Thus, Table 5 also presents the results of the estimations in the two methods limited to those with bachelor's degrees in the subjects offered by all types of institutions. While the multivariate estimation results have remained virtually unchanged, the two-stage estimation has seen a noticeable change: The return for university graduates increased greatly. The high and exceptional value for the return estimate for graduates

[43] We also made placebo estimations, where we pushed forward the year in which the department opened by three years (recalculating the availability variables accordingly). It turns out that in the first stage estimations, many of the estimators are not in the right direction or are not significant, and the deviance value also dropped. These findings strengthen the reliability of using distance as an instrumental variable.

[44] When defining availability in terms of number of students (the fifth definition), a relatively high proportion of first-stage estimators were not in the correct direction and deviance values were low. For this reason, we decided to drop off this instrumental variable.

of “other universities” should be treated with caution, since in the first stage equation, their availability variables receive a relatively low deviance value (not shown).

In sum, the two-stage estimation of the common study subjects shows that graduates who have studied for a bachelor's degree in elite universities and private colleges earn annual wages that are about 15 percent higher than those earned by public college graduates; however, the multivariate estimate suggests that university graduates (of both types) and private colleges earn wages that are 9–11 percent higher than those of public college graduates.

It is surprising to find that the return on universities in the two-stage method is higher than in the multivariate estimation, since it is likely that the two-stage method better controls for the selectivity in admissions by higher education institutions. This may be due to the much greater availability of public colleges, which has mostly allowed students of poor socioeconomic backgrounds as well as those with low abilities to enroll in the higher education institutions, and some of these characteristics are unobservable and negatively correlated with wages. The two-stage estimation is based on changes in availability and the estimates are therefore sensitive to the inclusion of this population and the bias resulting from the unobservable characteristics under consideration.

Figure A-10 in the Appendix shows the returns by type of institution for each subject separately, provided that the instrumental variable in the first stage equation successfully passed the significance test. The following general picture emerges: In most subjects, the return is higher at “other universities”. When it comes to engineering, however, the relative return for graduates of elite universities is relatively high, while being relatively low for the humanities and social sciences.

Table 4. The Annual Wage Premium on Undergraduate Degree,[1] 2008–15

Based on the two-stage estimations

The availability variable in the first stage equation:[2]	Distance (km)	Distance log	An institution of this type is within no more than 50 km	No. of institutions of this type within a maximum of 50 km
Elite universities[3]	0.036**	0.029*	0.043**	0.011
	(0.018)	(0.016)	(0.017)	(0.017)
Other universities[3]	0.188***	0.157***	0.235***	0.241***
	(0.024)	(0.024)	(0.030)	(0.031)
Private colleges[3]	0.098***	0.121***	0.102***	0.144***
	(0.024)	(0.022)	(0.025)	(0.023)
The controlled variables[4]	V	V	V	V
No. of observations	549,989	549,989	549,989	549,989
Adjusted R^2	0.25	0.25	0.25	0.25

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

Standard deviations were corrected according to Davidson and MacKinnon (2010).

(1) Including individuals who completed their master's degrees in the years following the wage year (and did not study during that year).

(2) The minimum distance between the locality in which the student resided at age 17 and localities with institutions of a given type, provided that the institutions offered the student's study subject during his/her first year of enrollment.

(3) Baseline group: The public colleges.

(4) The controlled variables in Table 1 (Model 4).

Table 5. Annual Wage Premium on a Bachelor's Degree:[1]

Comparison Between the Two-Stage and Multivariate Estimations

	All subjects		Subjects common to all types of institutions[2]	
	Two-stage estimation[3]	Multivariate estimation	Two-stage estimation[3]	Multivariate estimation
Elite universities[4]	0.029*	0.117***	0.137***	0.106***
	(0.016)	(0.007)	(0.024)	(0.011)
Other universities[4]	0.157***	0.105***	0.395***	0.087***
	(0.024)	(0.005)	(0.045)	(0.007)
Private colleges[4]	0.121***	0.090***	0.161***	0.103***
	(0.022)	(0.007)	(0.031)	(0.008)
The controlled variables[5]	V	V	V	V
No. of observations	549,989	549,989	290,106	290,106
Adjusted R^2	0.25	0.25	0.26	0.26

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

Standard deviations were corrected according to Davidson and MacKinnon (2010).

(1) Including individuals who completed their master's degrees in the years following the wage year (and did not study during that year).

(2) Psychology, political science, economics, social sciences - other, business administration, computer science and industrial engineering and management.

(3) In the first stage equation, the instrumental variable is the minimum log distance between the locality in which the student resided at age 17 and localities with institutions of a given type, provided that the institutions offered the student's study subject during his/her first year of enrollment.

(4) Baseline group: The public colleges.

(5) The controlled variables in Table 1 (Model 4).

Fuzzy regression discontinuity method

As in the two-stage estimations, we also limited the discontinuity estimation method to undergraduate students, since they are based on differences in the admissions thresholds for an undergraduate program, and also since admission to graduate studies largely depends on factors that are unavailable to us (such as grades in undergraduate studies). In addition, the estimations compared the elite universities to the "other universities", omitting the colleges, for two reasons: a) For undergraduate enrollments at universities, we had full data for all the research years, but had none from colleges for the years prior to 2009. b) Between 2009 and 2012, very few applied simultaneously to universities and colleges, and the same is true for private and public colleges (see also Table A-5 in the Appendix).

Before describing the results, it appears that the data meet the necessary conditions for using the fuzzy regression discontinuity method. Figure A-11 in the Appendix focuses on applicants to both elite universities and other universities, and shows the distributions of psychometric test scores among graduates of each type of institution. It shows that the distributions are similar, and that among graduates of elite universities, the distribution is shifted slightly to the right (a similar picture

emerges from the percentile of the average matriculation grade—not shown). Figure A-12 in the Appendix refers to the key controlled variables in the wage equations and shows their values around the admissions threshold for study programs at elite universities. We conclude from it that there is no discontinuity in their values around the threshold, including in matriculation grades and psychometric scores, a finding that confirms the hypothesis that applicants cannot adjust for the threshold. These two characteristics—the large overlap in the distribution of abilities and the continuity of the controlled variables around the admissions threshold of a study program—are a prerequisite to using the fuzzy regression discontinuity method.

Table 6 shows the annual return on bachelor's degrees from elite universities compared to the return on bachelor's degrees from "other universities". It presents the results generated by the reduced equation (Equation 4) and the second stage of the two-stage equation (Equation 6) for different periods around the admissions threshold. The key finding is that there are no significant differences between the returns on the two types of universities. However, if the period around the admission threshold is reduced, the (non-significant) return gap in favor of elite universities increases in the second-stage equation.

We also made estimations for departments with at least 100 bachelor's degree graduates in each type of university, and these graduates also enrolled simultaneously in both types of institutions (law, para-medical professions, industrial engineering and management, and electrical engineering). We found no significant differences in return between the two types (not shown), similarly to the multivariate estimation results (Figure 3 above).

Table 6. The Wage Premium on Bachelor's Degrees[1] from Elite Universities Compared to "Other Universities", 2008–15

Based on the discontinuity in admissions to an academic department

Distance from the admissions threshold:[1]	No limit	1± Standard deviation	0.75± Standard deviation	0.50± Standard deviation
The reduced form equation[2]	0.022 (0.026)	0.033 (0.040)	0.042 (0.046)	0.006 (0.052)
The second stage equation[3]	0.184 (0.177)	0.083 (0.184)	0.159 (0.224)	0.249 (0.231)
The controlled variables[4]	V	V	V	V
No. of observations	36,316	26,174	21,771	16,252
Adjusted R^2	0.32	0.32	0.33	0.33

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses. Standard deviations were corrected according to Davidson and MacKinnon (2010).

(1) One standard deviation equals 100 points in the psychometric test.

(2) Equation (4).

(3) Equation (6).

(4) The controlled variables in Table 1 (Model 4), except for the average matriculation grade and psychometric test score.

(b) Return by type of institution in terms of hourly wage

Before we turn to return per hourly wage, we will estimate the differences in the number of weekly working hours between individuals who have earned a bachelor's degree in the various types of institutions, with all other characteristics being equal; this estimate relies in part on the 2008 census.[45] As shown by Table A-6 in the Appendix, men who attended elite universities and women who attended private colleges work about 6 percent and 4 percent more hours, respectively, than their public college counterparts do. When examining the number of annual working hours (after also taking into account the number of working months per year), similar results are obtained (Table A-11 in the Appendix).

We used the OLS method to estimate the gross hourly wage equation in 2008,[46] based on a combination of the 2008 census and the administrative file tracking those born in 1978–85. As shown by Table 7, graduates of universities and private colleges earn 4–6 percent more than

[45] We limited the estimations to subjects who obtained only a bachelor's degree by the time of the census, since during that time, only a negligible percentage of college graduates studied for a master's degree. In addition, and as we did previously, we removed from the estimations individuals who were enrolled in undergraduate studies in 2008, as their wages do not necessarily reflect their earning capacity as college and university graduates. Both restrictions seem to bias downwards the estimators of bachelor's degrees from universities, since graduate students tend to be, on average, more talented than others. This is even more true of elite universities, as a greater percentage of their graduates with bachelor's degrees pursue graduate degrees.

[46] It is impossible to perform two-stage estimations since the instrumental variables in the first-stage equations are not significant due to the paucity of observations.

public college graduates (with no significant differences between universities' and private colleges' returns). This result contradicts findings regarding the annual wages hierarchy among holders of undergraduate and graduate degrees in 2008–15. The contradiction can be resolved as follows (see Table A-7 in the Appendix): In 2008, there are no significant differences in annual wages among those with bachelor's degrees from the different types of institutions (except for lower wages of public college graduates), both among all graduates and among those included in the census; the hierarchy of annual working hours by type of institution is the opposite of the annual wages hierarchy; thus, the gaps between hourly wages of graduates of the different types of institutions are even further diminished.[47] The hierarchy of hourly wages by subject and type of institution is heterogeneous (Figure 4).

Figure A-13 in the Appendix shows hourly wages by academic subject compared to those of graduates of economics, and relates both to the gross figure and the figure after controlling for personal characteristics. The hierarchies are similar to those obtained for annual wages in both this study (Figure A-6 in the Appendix) and in Krill, et al. (2019). Here, too, the gaps in gross wages are far wider than those after adding the control variables, showing that employers reward abilities.

[47] As mentioned above, we estimated the annual wages for holders of bachelor's and master's degrees, but estimated the hourly wages for holders of bachelor's degrees—for holders of bachelor's degrees at the time of the 2008 census. When restricting the annual wage estimations in 2008-2015 to holders of bachelor's degrees—as we did in Table 1, Model 4—we find that the wages of private college graduates increase greatly relative to those of public college graduates (see Table 5 above). This finding is consistent with the following two facts: a) The percentage of private college graduates who have pursued a master's degree is higher than their percentage in the public colleges; b) Graduates of private colleges who have pursued their master's degrees in these colleges have abilities (matriculation grades and psychometric scores) only slightly more than graduates who did not pursue graduate studies, while the gaps among the graduates of the public colleges are higher. Hence, the population of graduate students in private colleges is less selective than in public colleges, and may very well be that a similar picture exists with regard to the unobservable abilities that are correlated with wages.

Table 7. Hourly Wage Premium for Undergraduates by Gender and Nationality[1], 2008

	Total[2]	Men	Women	Jews
Elite universities[3]	0.054*	0.030	0.044	***0.076
	(0.029)	(0.048)	(0.036)	(0.029)
Other universities[3]	0.038*	0.022	*0.045	0.029
	(0.022)	(0.041)	(0.027)	(0.022)
Private colleges[3]	0.065***	0.055	**0.072	**0.057
	(0.025)	(0.045)	(0.030)	(0.025)
The controlled variables[4]	V	V	V	V
No. of observations	5,047	1,639	3,408	4,495
Adjusted R^2	0.222	0.240	0.184	0.256

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

Only individuals who have completed their bachelor's degrees by 2008 (and were not enrolled in 2008). Individuals who studied for their master's degrees in later years were also included.

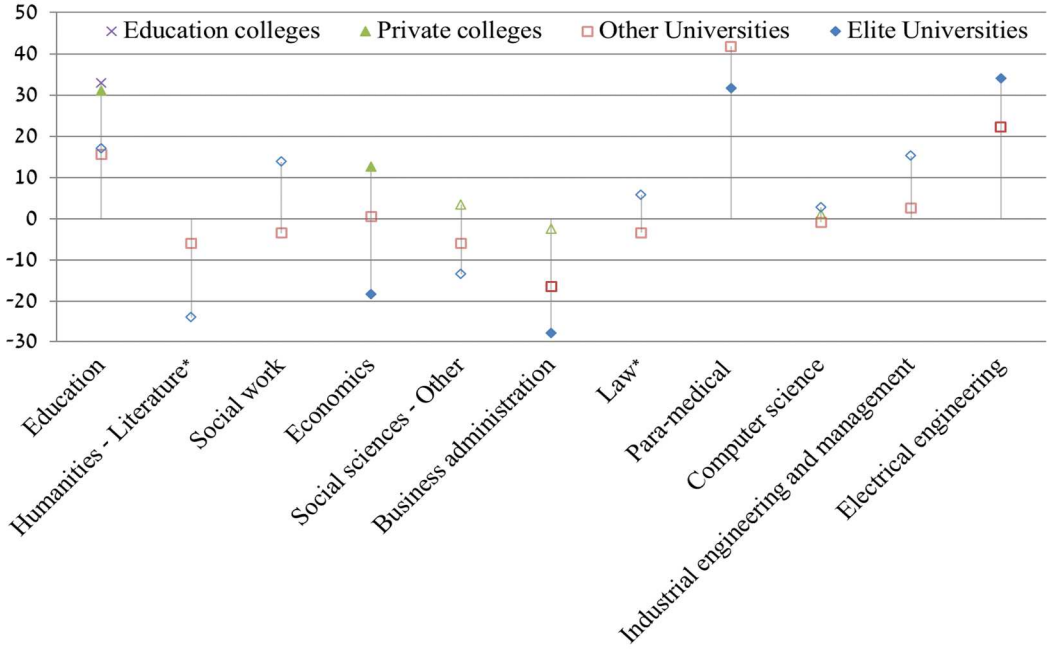
(1) All holders of bachelor's degrees.

(2) Baseline group: The public colleges.

(3) The controlled variables included in Table 1, Model 4.

Figure 4

Hourly Wage Premium for Holders of Bachelor's Degrees, by Subject[1] and Type of Institution,[2] 2008 (percent)



Source: Based on Central Bureau of Statistics data processed by the authors.

* Baseline group: Private colleges.

A pale square and empty diamond and triangle represent a non-significant 10 percent estimate.

(1) Major subject. The figure includes subjects offered by at least two types of institutions, with at least 50 graduates each.

(2) Based on the estimates of the dummy variables for the type of institution in estimations such as those in Table 1, Model 4. The estimations were made separately for each subject. Baseline group: Graduates of public colleges.

6. Summary

Our study examined the wage premium for studying in higher education institutions in Israel at a time when colleges have been expanding rapidly throughout the country.

The study follows up all those born from 1978 to 1985, and includes their socio-demographic features, their family background, their cognitive abilities, their enrollment in educational institutions, academic subjects, degrees, and, of course, the wages they earned over several years. The database therefore covers many cohorts and wage years, and this fact—along with the rapid expansion of the higher education system—has allowed us to examine how the return to education has evolved over the years.

The rich database also allowed us to adopt three estimation methods, each of which tackles the selectivity problem differently: First, we applied the method most commonly used in the literature—multivariate estimation under the selection on observables approach (OLS). We added to that the two-stage least squares (TSLS) estimation, which uses the instrumental variable "geographic proximity to the educational institution", and discontinuity in admissions to an academic department (fuzzy regression discontinuity). Naturally, the first method is suitable for all graduates, while the other two are suitable for holders of bachelor's degrees only.

In the first stage, we made estimations among individuals who completed a bachelor's or master's degree. The OLS estimation shows that, all else being equal, the gross annual wage among university graduates between 2008 and 2015 was about 10 percent higher than that of public college graduates, and wages among graduates of private colleges were about 6–7 percent higher. The wage gaps remained stable even after breaking down the data by graduation year and the number of years that have elapsed since. The annual wage hierarchy was maintained when broken down by gender, nationality, and parental income; exceptions to the rule were graduates of private colleges whose parents are well off, who earned more than university graduates. The gross hourly wage among university graduates was similar in 2008 to the wage among graduates of private colleges, and about 4–6 percent higher than the wages of public college graduates. When the data is segmented according to academic subjects, the type of institution is ranked differently in terms of graduates' wages; however, the annual and hourly wages of engineering and para-medical graduates are higher if they study at universities, while graduates of business administration programs who enrolled in colleges earn more.

In the next stage, we made estimations only among holders of bachelor's degrees, and the three methods yielded a similar wage hierarchy by type of institution. The multivariate

estimation showed that the annual wages of graduates of universities and private colleges was about 10 percent higher than the wages of public college graduates. The TSLS method shows that graduates of universities and private colleges earn about 20 percent more and 14 percent more than graduates of public colleges, respectively. In the fuzzy regression discontinuity method, no differences were found between the wages of graduates of elite universities and other universities. The latter result is consistent with the findings we presented above and with studies conducted around the world. They show that when controlling for multiple variables, including personal abilities, OLS estimations yield results similar to those obtained by using the other methods.

The higher education reform in Israel has had a positive effect on accessibility to tertiary education, and increased earnings (including graduates of public colleges). However, at the same time, consideration should be given to ways of reducing the quality gaps between institutions, partly by improving faculty and the learning environment in colleges and maintaining an adequate academic level. When the greater prevalence of higher education is not accompanied by acquiring the skills needed by the labor market, the result is over-education. This phenomenon is more prevalent in Israel than in most OECD members, and has adverse impacts on employees, employers and the economy (McGowan and Andrews, 2015; OECD, 2016). This issue deserves a separate study.

In sum, we note that the study examined the quality of higher education institutions only in terms of wages. While this is the most common measure, the quality of the institutions can also be examined in terms of other outputs, such as their contribution to research and to students' satisfaction during their studies and after their integration into the labor market. Only scant information is available for some of those outputs, and databases should be created to explore them.

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Appendices

Table A-1. Subjects of Study in Institutions of Higher Education

Subjects of study grouped for research	Subjects of study by CBS definition
Education	Education
	Education and research in education
	Didactics
	Educational administration
	Educational counselling
	Special education
	Educational psychology
	Science teaching
	Teaching certificate
	Mathematics and computer sciences teaching
	Technology teaching
	Physical education
Humanities - Religions	Bible
	Talmud (oral law)
	Judaism
	Multi-disciplinary – Jewish studies
	General philosophy
	Jewish philosophy
	History of Jewish thought
	Archeology
	Other humanities
	Contemporary Judaism
	Multi-disciplinary – humanities
	Classical studies
	History of the Islam and its culture
	Spanish and Latin-American studies
	Russian and Slavic studies
	East Asia studies
	Jewish folklore
	Humanities
	Honors
	General
	General studies
Humanities – History	Philosophy and history of sciences
	General history
	Israeli history
	General history and Israeli history
	History of Islamic countries
	Land of Israel studies
	History of Africa
Humanities – Literature	Hebrew language
	Hebrew literature
	General literature
	Arabic language and literature
	Indian, Iranian and Armenian studies
	Ancient Semitic Languages
	Assyrian
	Egyptian
	Yiddish language and literature
	English language and literature
	French language and literature
	Italian language and literature

	German language and literature
	Linguistics
	Semitic linguistics
Art	History of art
	Arts
	Music
	Musicology
	History of the theatre
	Cinema and television
	Dance
	Library science
Design	Industrial Design
	Interior design
	Interior design – colleges
Architecture	Architecture and urban planning
	Landscape architecture
Sociology	Sociology and anthropology
Political science	Political science
	International relations
Psychology	Psychology
Social work	Social work
Economics	Economics
	Agricultural economics
Accounting	Accountancy
Social sciences – Other	Geography
	Criminology
	Communications
	Behavioral sciences
	Multi-disciplinary – social sciences
	Combined social sciences subjects
	Social sciences
Business administration	Business administration
	Labour studies
	Management and public administration
	Public administration
	Management sciences and organizational behavior
	Management of health systems
	Management of hotels
	Banking
	Insurance
	Logistics
Law	Law
Para-medical	Pharmaceutics
	Optometry
	Communication disorders
	Nursing
	Occupational therapy
	Physiotherapy
	Nutrition and home economics
	Food resources management
	Public health
	Health and welfare services
	Human resource
	Emergency medicine
	Medical laboratory sciences
	Mathematics

Mathematics	Mathematics – physics
	Mathematics – computer sciences
	Mathematics in social sciences
	Exact sciences – multidisciplinary
	Statistics
Physics	Geophysics
	Physics
Earth science	Geology
	Climate sciences
	Meteorology
Chemistry	Chemistry
	Physical chemistry
	Industrial chemistry
	Biochemistry
Life science (excluding chemistry)	Botany
	Brain sciences
	Medical sciences
	Biotechnology
	Biology
	Other biological sciences
	General sciences
	Science
Agricultural Science	Agriculture
	Animal science
	Field crops and vegetables
	Horticulture
	Plant sciences
	Soil and water sciences
	Plant protection
	Nutrition
	Ecology
Industrial engineering and management	Industrial and management engineering
	Information systems engineering
Civil engineering	Civil engineering
	Structural engineering
	Geodetic engineering
	Environmental engineering
	Quality assurance
	Engineering sciences
	Engineering
Mechanical engineering	Mechanical engineering
Electrical engineering	Computer engineering – electrical
	Electronic engineering
	Communication systems engineering
	Aerospace engineering
Computer Science	Computer engineering – computer sciences
	Computer sciences
Chemical engineering	Food engineering and biotechnology
	Materials engineering
	Nuclear engineering
Biomedical engineering	Agricultural engineering
	Biomedical engineering
	Biotechnological engineering
Medicine	Medicine
	Dental medicine

Source: Central Bureau of Statistics.

Table A-2. Descriptive Statistics of Graduates of Institutions of Higher Education

Follow-up of 1978–1985 birth cohort

	Total		Elite universities		Other universities		Public colleges		Private colleges		Colleges of Education	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Number of graduates	155,794											
Distribution of graduates (share by row, %)	100		18.2		34.9		21.9		16.3		8.3	
Men (share, %)	39.7		45.7		36.2		47.9		43.0		12.1	
Age[1] (years)	27.2	2.2	27.0	2.0	26.9	2.2	28.0	2.1	27.3	2.0	26.9	2.8
Population group (distribution by column, %):												
Native Israeli who studied in the State secular Jewish school system	62.3	37.0	61.6		58.4		66.2		77.2		41.6	
Native Israeli who studied in the State religious Jewish school system	14.6	9.1	13.9		18.3		12.9		7.8		17.6	
Europe- or America-born individual who studied in the State secular Jewish school system	10.4	22.8	12.4		10.3		12.8		7.9		4.4	
Europe- or America-born individual who studied in the State religious Jewish school system	1.4	1.1	2.0		1.4		1.4		0.8		1.0	
Asia- or Africa- born individual (excl. Ethiopia)	0.4	2.7	0.3		0.4		0.6		0.4		0.4	
Jew of Ethiopian origin[2]	0.7	1.5	0.2		0.9		0.8		0.8		0.7	
Ultra-Orthodox	0.3	6.8	0.2		0.4		0.3		0.1		0.4	
Muslim (non-Bedouin)	6.0	13.8	6.1		5.1		2.9		3.0		24.0	
Bedouin	0.7	2.4	0.3		0.9		0.4		0.4		2.1	

Arab Christians	2.1	1.7	2.4		2.3		1.1		1.2		4.7	
Druze[3]	1.1	1.1	0.6		1.6		0.4		0.4		3.1	
Jews (share, %)	90.1	81.0	90.7		90.0		95.2		95.0		66.0	
Residential district at age 17 (distribution by column, %)												
Tel Aviv	15.0		10.6		12.7		14.3		28.5		1.2	
Central	26.5		22.8		24.9		25.4		37.7		21.3	
Jerusalem	7.9		17.7		4.4		7.3		5.7		6.5	
Haifa	15.4		18.6		16.8		15.1		9.0		16.6	
North	17.6		17.7		18.3		18.6		8.2		40.0	
South	13.9		7.4		19.6		15.1		9.0		10.3	
Judea and Samaria	3.7		5.2		3.3		4.2		1.9		4.1	
Married mother[4] (share, %)	91.2		91.1		91.5		90.4		91.0		92.2	
No. of siblings[4]	2.46	1.73	2.31	1.58	2.52	1.79	2.33	1.58	2.19	1.44	3.41	2.24
Parents' income percentile[5]	56.8	20.7	59.4	19.9	56.5	20.9	56.4	20.0	58.8	19.3	49.7	23.6
No. of schooling years – mother	13.1	3.3	14.0	3.2	13.1	3.4	13	3.1	13.1	3.0	11.6	3.6
No. of schooling years – father	13.2	3.4	14.4	3.5	13.2	3.5	13	3.2	13.1	3.2	12.0	3.5
Eligible for Bagrut matriculation diploma (share, %)	89.3		94.3		90.6		86.0		86.8		86.2	
Percentile of average matriculation grade[6]	59.7	16.0	68.1	14.1	60.9	15.5	54.7	15.8	55.7	15.3	[7]57.1	15.6
Advanced mathematics (5 units) (share, %)	24.0		46.3		27.2		14.4		12.8		8.6	
Those with more than 30 study units in high school diploma, (share, %)	21.5		34.5		24.1		17.3		9.6		16.8	
Psychometric test score	574	96	642	74	585	94	556	83	553	85	478	83
Percentile of psychometric score	60.3	27.6	78.8	19.2	63.4	27.0	55.3	25.1	54.4	25.7	32.0[7]	23.8
Married at age 30 (share, %)	27.2		30.3		25.7		30.2		29.1		14.9	
No. of children (at age 30)	0.70	0.98	0.56	0.87	0.76	1.01	0.60	0.89	0.53	0.81	1.44	1.28

Annual wage at age 30 (NIS '000, in 2015 prices)	108.2	80.1	124.5	95.3	109.4	79.0	105.1	76.0	109.1	79.2	73.5	39.8
Number of months of work per year at age 30	10.5	2.6	10.6	2.6	10.6	2.6	10.6	2.6	10.4	2.7	10.6	2.5
Monthly wage at age 30 (NIS '000, in 2015 prices)	10.1	6.8	11.6	8.2	10.1	6.7	9.7	6.2	10.4	6.9	6.8	3.6

Source: Based on Central Bureau of Statistics data processed by the authors.

(1) The age at completion of undergraduate degree.
(2) He/she or at least one of their parents immigrated from a Horn of Africa country or from Sudan.
(3) And Circassians.
(4) When the individual turned 17. Number of siblings including the individual.
(5) The parents' gross annual income received as salaried employees or self-employed when their child (the graduate of the institute of higher education) was 24. The percentile was calculated according to the father's age group, separately for each year, in order to take into account the income development over the life cycle.
(6) The average percentile of grades in subjects for each test's year weighted according to the number of study units in each subject.
(7) The percentile of the average Bagrut score among graduates of colleges of education, is similar to the percentile among all graduates, while the percentile of the Psychometric test are relatively low. There are two possible explanations for this: (a) Among college of education graduates, the share of Arabs is relatively high, and Arabs attain much lower psychometric test scores than Jews do; (b) some of the colleges of education accepted applicants based on a Bagrut score alone, and only applicants whose scores were low were required to take a psychometric test. As there is a relatively high correlation between Bagrut grades and the psychometric test grades, the latter is low as well.

Table A-3. Correlation Coefficients Between Key Variables in the Research

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Male	1													
2	No. of siblings[1]	-0.04	1												
3	Married mother[1]	0.01	0.13	1											
4	No. of schooling years – mother	0.05	-0.30	0.00	1										
5	No. of schooling years – father	0.06	-0.21	0.04	0.66	1									
6	Income percentile of parents[2]	0.04	-0.18	0.11	0.32	0.30	1								
7	Socioeconomic rating[3]	0.07	-0.31	0.00	0.38	0.35	0.29	1							
8	More than 30 study units in high school diploma	0.07	0.10	0.04	0.08	0.10	0.02	-0.04	1						
9	Advanced mathematics (5 units)	0.12	-0.02	0.03	0.11	0.13	0.06	0.02	0.31	1					
10	Percentile of average matriculation grade[4]	-0.15	0.01	0.02	0.1	0.12	0.04	0.03	0.24	0.31	1				
11	Psychometric test score	0.23	-0.23	0.00	0.35	0.33	0.24	0.38	0.19	0.39	0.37	1			
12	Psychometric test score –English section	0.21	-0.32	-0.03	0.36	0.34	0.23	0.40	0.09	0.26	0.30	0.83	1		
13	Psychometric test score – Verbal section	0.12	-0.15	0.00	0.31	0.29	0.21	0.35	0.18	0.28	0.37	0.91	0.70	1	
14	Psychometric test score – Quantitative section	0.28	-0.18	0.01	0.29	0.28	0.20	0.30	0.22	0.47	0.30	0.89	0.61	0.69	1

Source: Based on Central Bureau of Statistics data processed by the authors.
(1) When the individual turned 17. Number of siblings includes the individual.
(2) The parents' gross annual income received as salaried employees or self-employed when their child (the graduate of the institute of higher education) was 24. The percentile was calculated according to the father's age group, separately for each year, in order to take into account the income development over the life cycle.
(3) The socioeconomic rating of residents of the statistical area in which the individual lived at the time of the 1995 census.
(4) The average percentile of grades in subjects for each test's year weighted according to the number of study units in each subject.

Table A-4. Results of first stage: The Probability of Studying for an Undergraduate Degree[1] at a Given Type of Institution Compared with the Probability of Studying at a Public College[2]

	Distance (km)			**Log distance log**		
	Elite universities	Other universities	Private colleges	Elite universities	Other universities	Private colleges
Availability of elite university	-1.2E-02*** (3.4E-04)	8.8E-03*** (2.6E-04)	5.4E-04 (4.5E-04)	-0.362*** (0.011)	0.227*** (0.008)	-0.035*** (0.013)
Availability of other university	9.6E-03*** (3.5E-04)	-1.2E-02*** (2.6E-04)	6.5E-03*** (4.8E-04)	0.474*** (0.013)	-0.307*** (0.007)	0.187*** (0.012)
Availability of private college	-1.0E-03*** (2.6E-04)	7.6E-04*** (1.4E-04)	-1.8E-03*** (2.3E-04)	-0.015 (0.015)	0.148*** (0.009)	-0.254*** (0.011)
Availability of public college	3.8E-03*** (3.0E-04)	3.0E-04 (2.1E-04)	-4.4E-03*** (4.4E-04)	0.191*** (0.011)	0.025*** (0.007)	-0.074*** (0.011)
The controlled variables[3]	V	V	V	V	V	V
No. of observations	120,094	120,094	120,094	120,094	120,094	120,094
Pseudo R^2	0.40	0.18	0.42	0.40	0.18	0.43
Value of the Deviance for availability variables[4]	2,368	3,140	282	3,309	2,958	889
Availability variable:	**An institution of this type is within no more than 50 km**			**No. of institutions of this type within a maximum of 50 km**		
Availability of elite university	1.005*** (0.034)	-0.637*** (0.023)	-0.044 (0.042)	0.551*** (0.021)	-0.204*** (0.014)	-0.091*** (0.022)
Availability of other university	-1.099*** (0.038)	0.628*** (0.024)	-0.540*** (0.044)	-0.240*** (0.009)	0.096*** (0.006)	0.074*** (0.008)
Availability of private college	0.043 (0.035)	0.013 (0.025)	0.485*** (0.044)	0.018 (0.014)	-0.196*** (0.008)	0.171*** (0.010)
Availability of public college	-0.436*** (0.035)	0.205*** (0.025)	0.394*** (0.042)	-0.969*** (0.035)	0.501*** (0.021)	-0.340*** (0.039)
The controlled variables[3]	V	V	V	V	V	V
No. of observations	120,094	120,094	120,094	120,094	120,094	120,094
Pseudo R^2	0.40	0.17	0.42	0.39	0.17	0.42
Value of the Deviance for availability variables[4]	2,219	1,691	476	2,076	1,442	431
The availability variable:	**The number of students studying the subject at a given type of institution, if they are within 50 km[5]**					
Availability of elite university	5.5E-04*** (1.8E-05)	-3.1E-04*** (1.4E-05)	5.3E-05** (2.2E-05)			
Availability of other university	-1.3E-04*** (1.4E-05)	-1.8E-05*** (5.3E-06)	8.6E-05*** (7.0E-06)			
Availability of private college	3.8E-06 (8.8E-06)	-4.0E-05*** (4.4E-06)	3.2E-05*** (4.7E-06)			
Availability of public college	-2.0E-04*** (1.9E-05)	6.1E-06 (8.4E-06)	2.2E-05** (9.8E-06)			
The controlled variables[3]	V	V	V			
No. of observations	120,094	120,094	120,094			
Pseudo R^2	0.39	0.17	0.42			
Value of the Deviance for availability variables[4]	1,530	745	301			

Source: Based on Central Bureau of Statistics data processed by the authors.
*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.
(1) Includes also individuals who studied for a graduate degree in later years.
(2) The results are logistic estimates of equation 2. The minimum distance between the locality in which the student lived at age 17 and the localities that had a given type of institution, provided that the institutions offered the student's course of study in the first year.
(3) The controlled variables included in Table 1, Model 4.
(4) A parallel index to the F-statistic in OLS estimations. A deviance with a value of 40 is equal to (from the P-value perspective) an F-statistic with a value of 10.
(5) First year students in the student's course of study.

Table A-5. Combinations of Registrations for Bachelor's Degrees: Their Distribution by Type of Institution[1], 2010 (percent by row)

	Elite universities	Other universities	Private colleges	Public colleges	Total
Elite universities	33.9	43.3	7.6	15.2	100
Other universities	23.6	51.4	6.2	18.7	100
Private colleges	5.8	8.8	71.3	14.1	100
Public colleges	7	15.9	8.4	68.6	100

Source: Based on Central Bureau of Statistics data processed by the authors.
1) Doesn't include registrations for 3 or 4 types of institutions, which make up about 4.9 percent of total registrations. Along the diagonal are the registrations for only a single institution. In every type, there is probably a registration for more than one institution.

Table A-6. (Log) Number of Weekly Work Hours Among Graduates of the Institutions of Higher Education[1], 2008

According to the combination of the 2008 census and the follow-up file for those born in 1978–85

	Total	Men	Women	Jews
Elite universities[2]	0.012 (0.016)	0.064*** (0.021)	-0.008 (0.022)	0.003 0.016
Other universities[2]	0.014 (0.012)	0.020 (0.019)	0.018 (0.016)	0.019 0.012
Private Colleges[2]	0.031** (0.013)	0.013 (0.020)	0.044** (0.017)	0.026* 0.013
The controlled variables[3]	V	V	V	V
No. of observations	5,047	1,639	1,639	1,639
Adjusted R^2	0.193	0.110	0.184	0.176

Source: Based on Central Bureau of Statistics data processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

(1) Only individuals who completed a bachelor's degree by 2008 (and did not study in 2008). Individuals who studied for a graduate degree in later years are also included.

(2) Baseline group: The public colleges.

(3) The controlled variables included in Table 1, Model 4.

Table A-7. The Annual and Hourly Wage Premium and the Number of Yearly Work Hours[1] for Undergraduate Degree Holders, by Gender, 2008

	The follow-up file for those born 1978–85	**The combination of the 2008 census and the follow-up file for those born 1978–85**		
	Annual Wage	Annual Wage	Annual work hours	Hourly wage[2]
	Total			
Elite universities[3]	0.076***	0.089**	0.014	0.054*
	(0.015)	(0.040)	(0.027)	(0.029)
Other universities[3]	0.078***	0.099***	0.044**	0.038*
	(0.011)	(0.030)	(0.021)	(0.022)
Private colleges[3]	0.107***	0.135***	0.062***	0.065***
	(0.013)	(0.032)	(0.023)	(0.025)
No. of observations	41,686	5,101	5,047	5,047
Adjusted R^2	0.239	0.279	0.173	0.222
	Men			
Elite universities[3]	0.105***	0.099	0.083**	0.03
	(0.025)	(0.061)	(0.036)	(0.048)
Other universities[3]	0.114***	0.065	0.053	0.022
	(0.019)	(0.045)	(0.032)	(0.041)
Private colleges[3]	0.042*	0.094*	0.029	0.055
	(0.023)	(0.049)	(0.033)	(0.045)
No. of observations	13,866	1,666	1,639	1,639
Adjusted R^2	0.245	0.296	0.118	0.240
	Women			
Elite universities[3]	0.068***	0.065	-0.013	0.044
	(0.019)	(0.052)	(0.036)	(0.036)
Other universities[3]	0.076***	0.121***	0.049*	0.045*
	(0.014)	(0.038)	(0.027)	(0.027)
Private colleges[3]	0.149***	0.162***	0.082***	0.072**
	(0.016)	(0.041)	(0.030)	(0.030)
No. of observations	27,820	3,435	3,408	3,408
Adjusted R^2	0.203	0.227	0.157	0.184

Source: Based on data of the Central Bureau of Statistics and processed by the authors.

*, **, *** Significant at 10 percent, 5 percent and 1 percent, respectively. Standard deviations (clustered at the individual level) appear in parentheses.

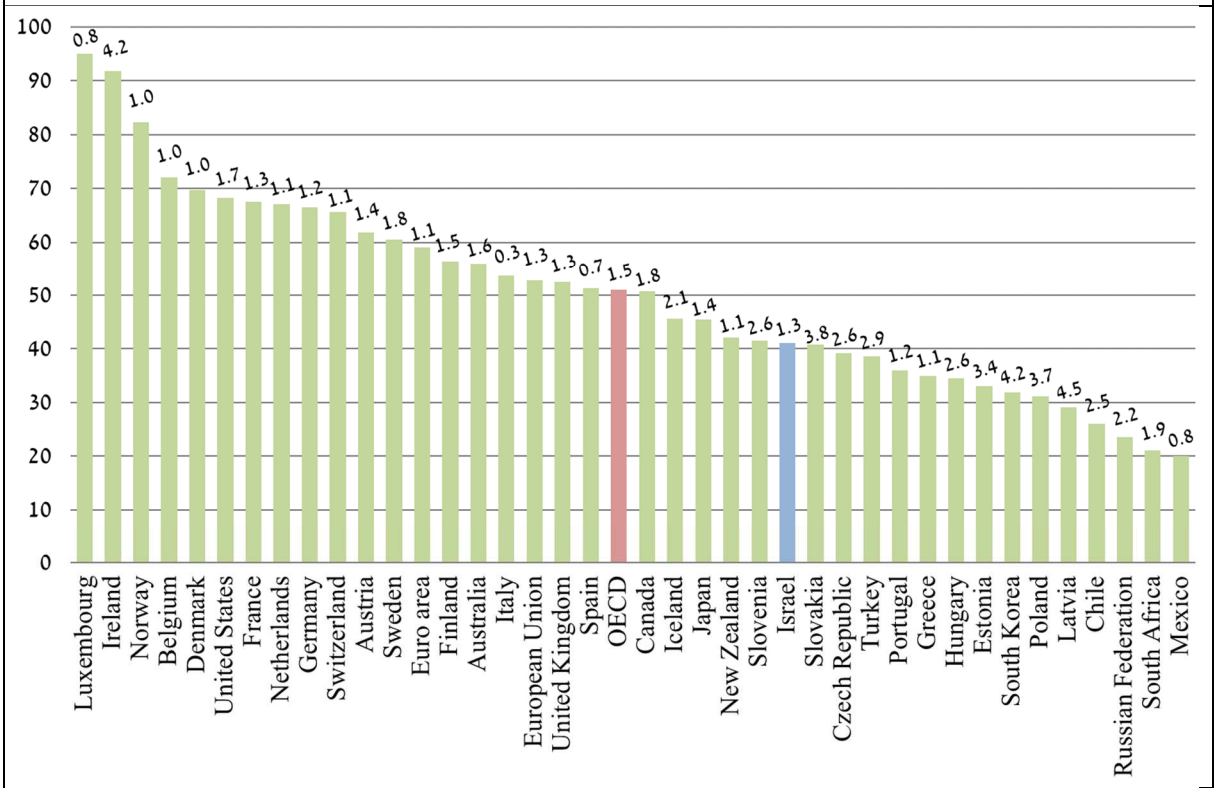
(1) Only individuals who have completed their bachelor's degrees by 2008 (and were not enrolled in 2008). Individuals who studied for their master's degrees in later years were also included. All the estimations included the controlled variables included in Table 1, Model 4. In all estimations (including annual work hours), the dependent variable is presented as a log.

(2) Identical to the results in Table 7.

(3) Baseline group: The public colleges.

Figure A-1. GDP Per Hour Worked in 2015 and its Average Annual Changes in 1995–2015, Israel and Other OECD Countries

(Columns represent the GDP in dollar PPP terms, and the values above them—the rate of change in percent)[1]



Source: OECD Compendium of Productivity Indicators 2017 and authors' calculations.

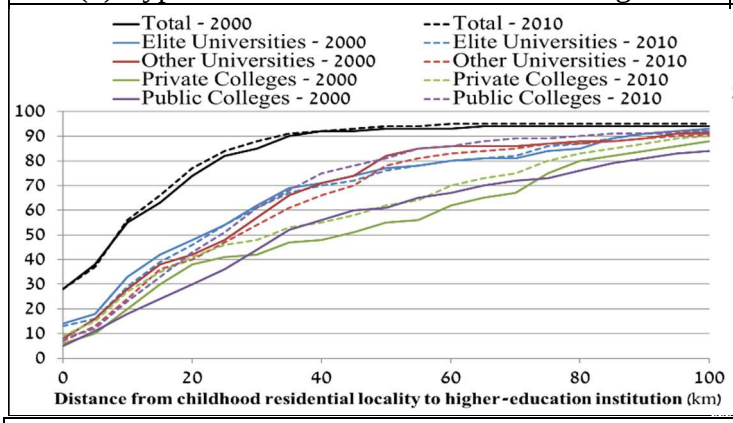
(1) GDP data and rates of change for South Africa refer to 2014 and 2001–14, respectively. The rate of change for Estonia refers to 2000–15.

Figure A-2. Availability of Higher-Education Institutions For the Research Population

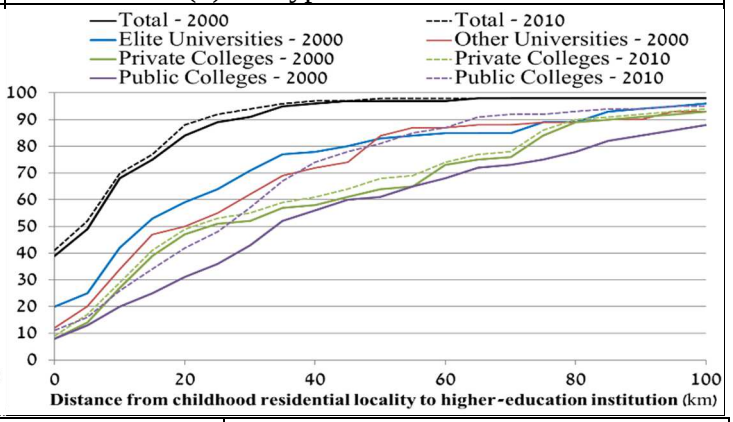
(First-year undergraduate students)

a. Cumulative distribution of the minimum distance between residential locality in childhood and locality in which the given type[1] of institution is located (percent)

(1) Type of institution in which studies began

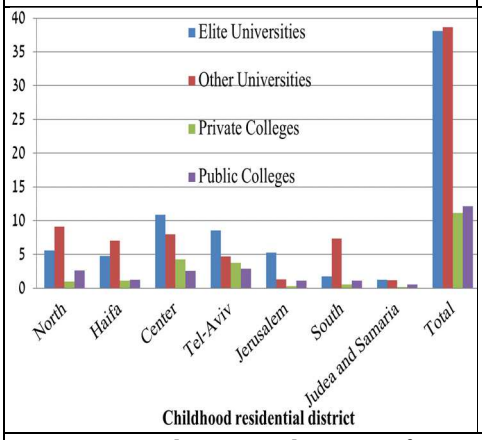


(2) All types of institutions[2]

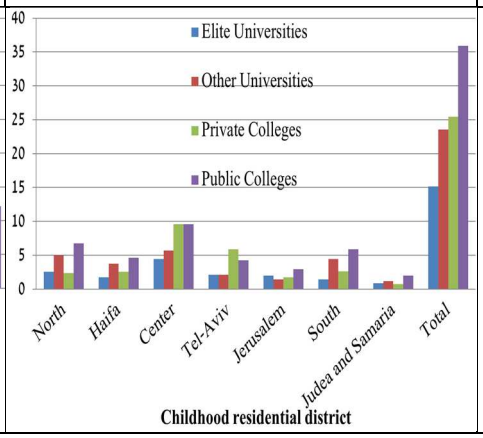


b. Breakdown of residential districts[3] by type of institution and year (percent)

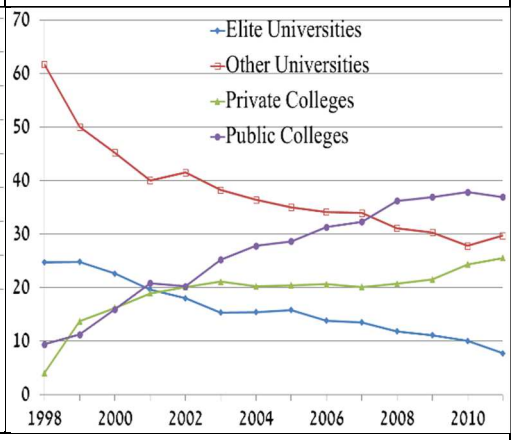
2000



2010



c. The probability of studying at a given type of institution, 1998-2011[4] (percent of total first-year students)



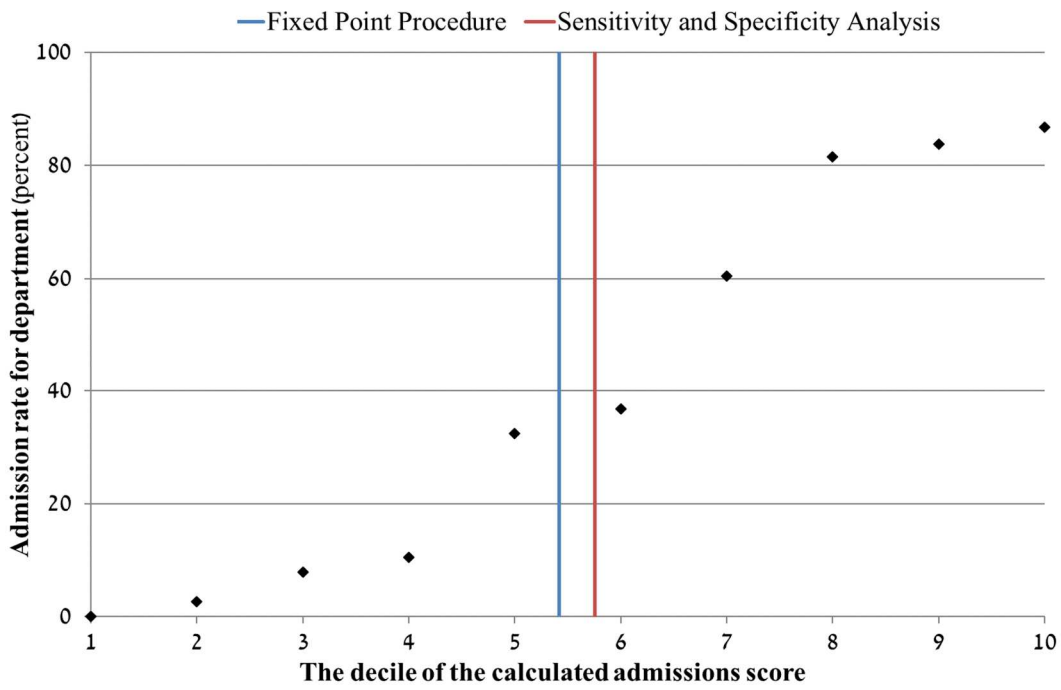
Source: Based on Central Bureau of Statistics data processed by the authors.

(1) The minimum distance (geodesic distance) between residential locality at age 17 and the locality in which the given type of institution is located, provided that in the registration year the institution offered the course of study that the graduate began to study. When the institution is located in the residential locality, the distance is zero, and when the institution did not teach the course of study, 1,000 kilometers were attributed to it.

(2) We took students who began studying for an undergraduate degree in 2000, calculated the distance they traveled, and compared it to the distance they would have had to travel if they began studying in 2010 (provided that the residential locality and course of study did not change).

(3) District of residence at age 17. Based on estimating equation 2 (with log distance) and averaging the values of each type of institution each year.

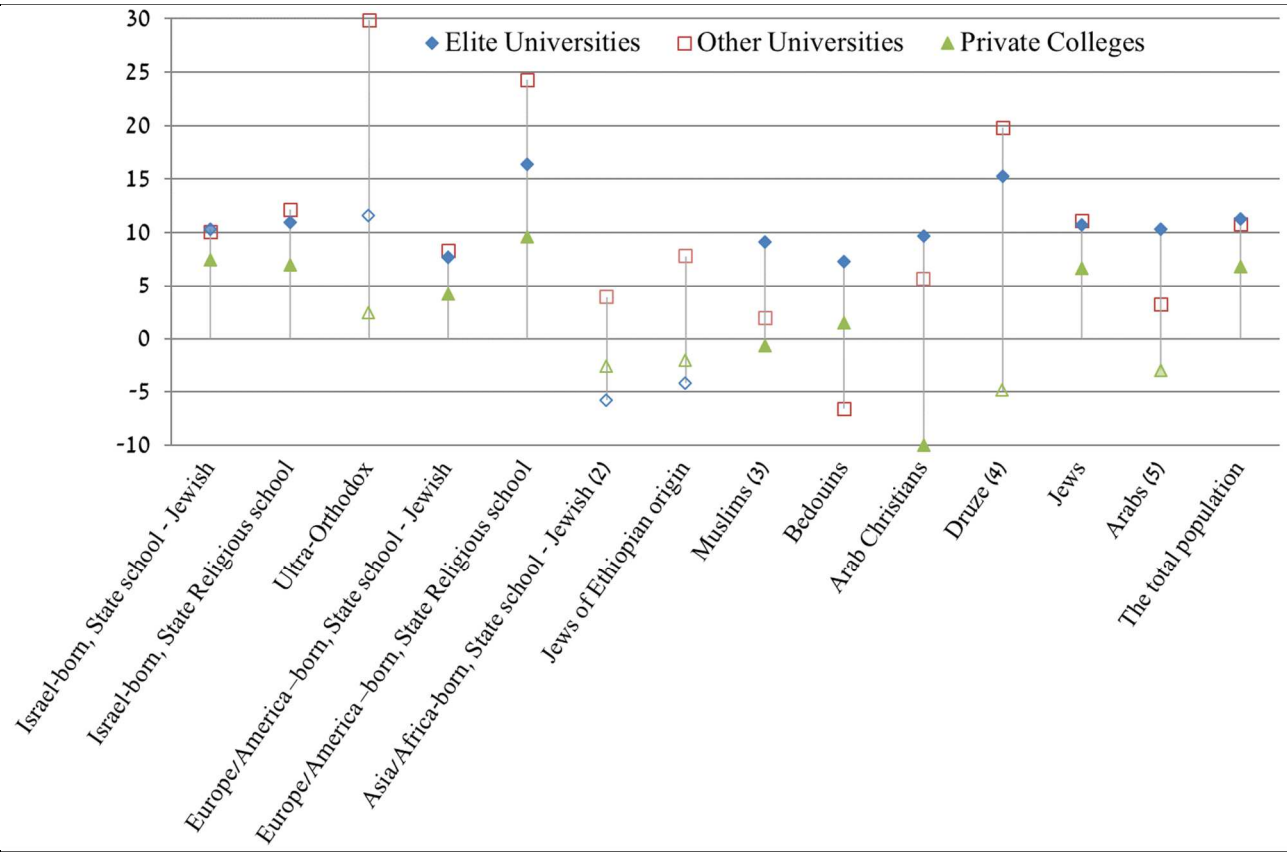
Figure A-3. The Admission Rate for Electrical Engineering at One of the Elite Universities in a Given Year, by Decile of the Calculated Admission Score, and Admission Score Thresholds Derived from Fixed Point Procedure and Sensitivity and Specificity Analysis



Source: Based on Central Bureau of Statistics data processed by the authors.

Figure A-4. Annual Wage Premium to Higher Education by Population Group, 2008—15[1]

(percent)



Source: Based on Central Bureau of Statistics data processed by the authors.

A pale square and empty diamond and triangle represent a non-significant 10 percent estimate.

(1) Based on the estimates of the dummy variables for the type of institution, such as those in Table 1, Model 4. The estimations were made separately for each population group.
Baseline group: Graduates of public colleges.

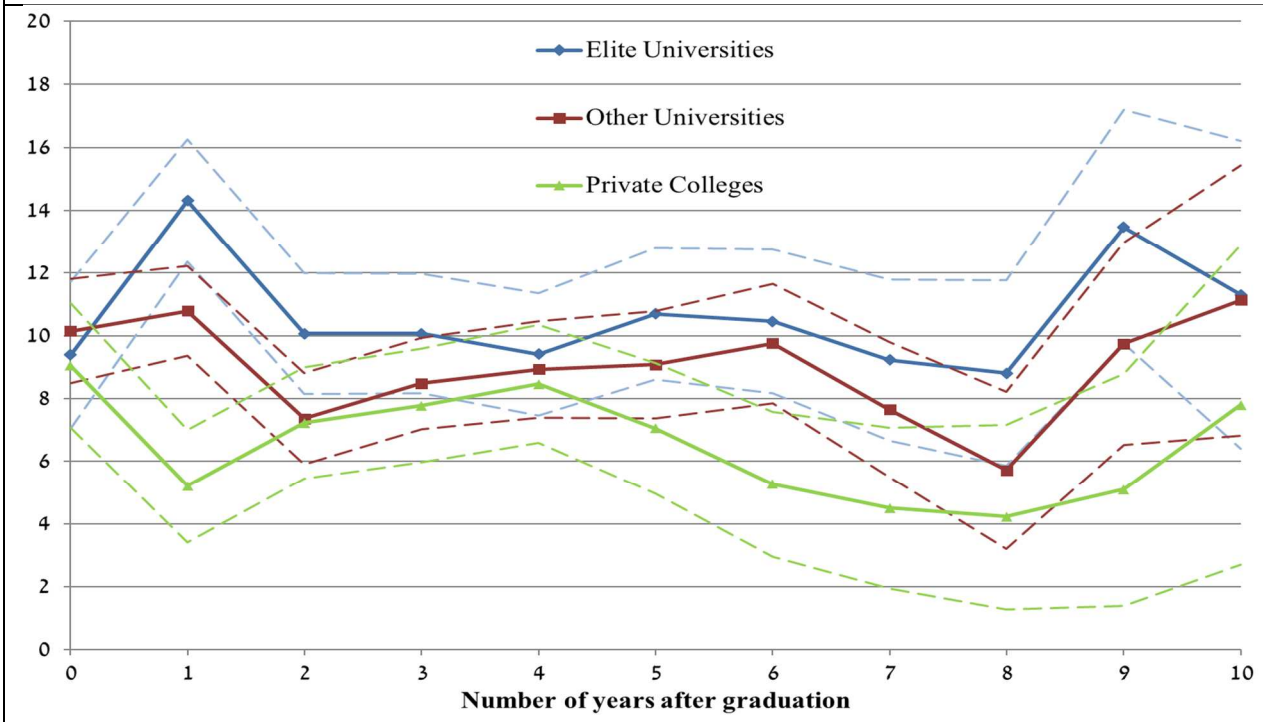
(2) That are not from Ethiopia.

(3) Muslims that are not Bedouin.

(4) Includes Circassians.

(5) Includes Druze and Circassians.

Figure A-5. Annual Wage Premium on Higher Education, by Number of Years that Elapsed Since the Completion of the Undergraduate Degree, 2008–15[1] (percent)

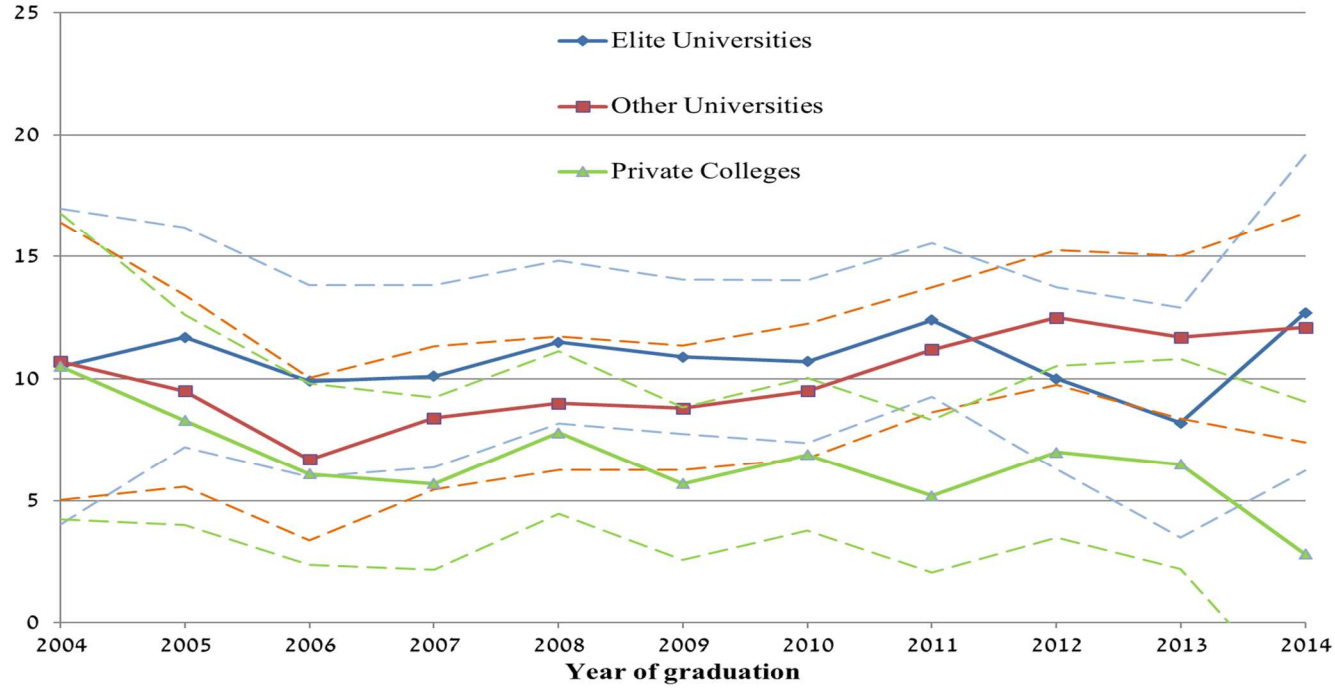


Source: Based on Central Bureau of Statistics data processed by the authors.
The broken lines represent confidence intervals of 95%.
(1) Based on the estimates of the dummy variables for the type of institution, such as those in Table 1, Model 4. The estimations were made separately for each year that passed since the completion of the degree. We added to the estimations an independent variable representing how many years of higher education the individual acquired since the completion of the undergraduate degree (such as in graduate degree studies).
Baseline group: Graduates of public colleges.

Figure A-6. Annual Wage Premium on Higher Education,

by Year of Completion of Undergraduate Degree,

2008–15[1] (percent)



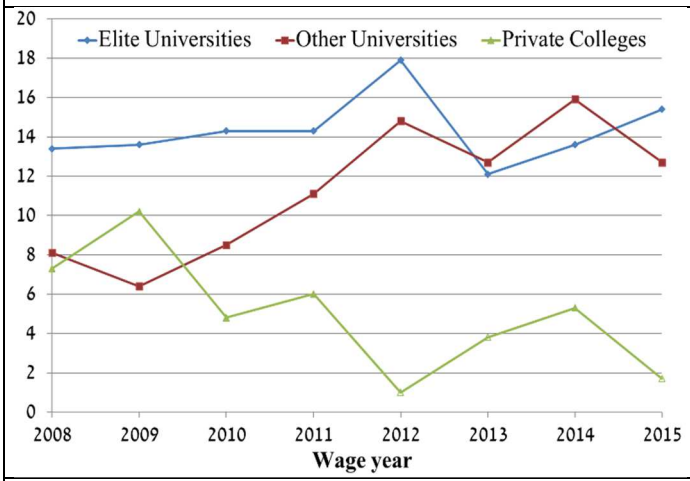
Source: Based on data of the Central Bureau of Statistics and processed by the authors.

The broken lines represent confidence intervals of 95%.

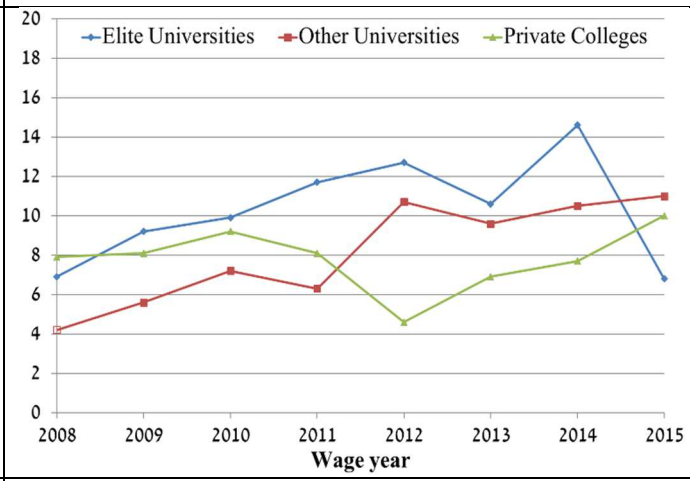
(1) Based on the estimates obtained by the dummy variables for the type of institution in estimations such as those in Table 1, Model 4. The estimations were made separately for each year of graduation.

Figure A-7. Annual Wage Premium on Higher Education, by Number of Years that Elapsed Since the Completion of Undergraduate Degree and the Wage Year[1] (percent)

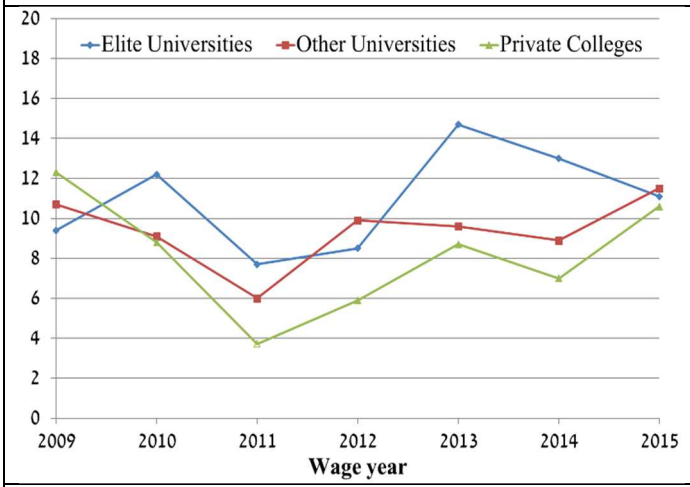
a. 1 year since completion of degree



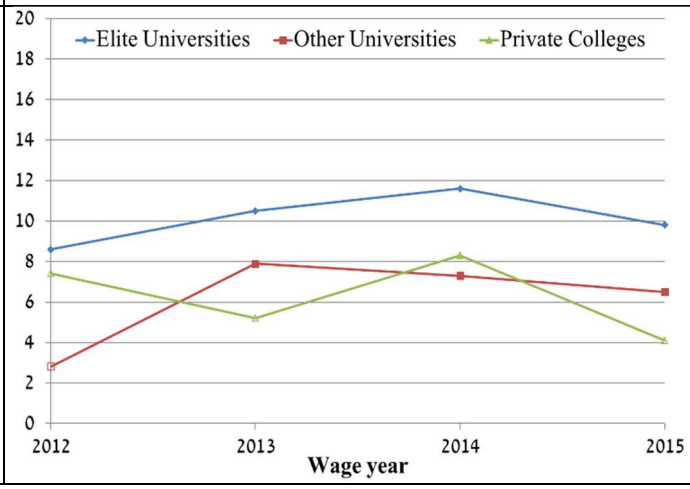
b. 3 years since completion of degree



c. 5 years since completion of degree



d. 8 years since completion of degree

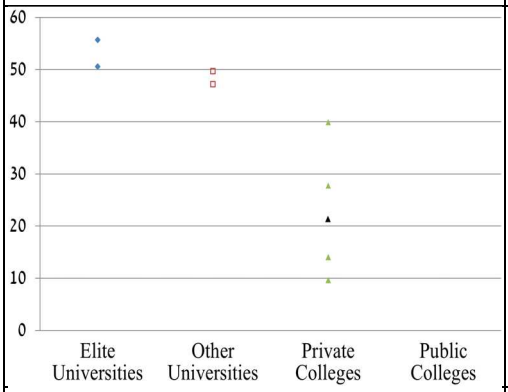


Source: Based on Central Bureau of Statistics data processed by the authors.

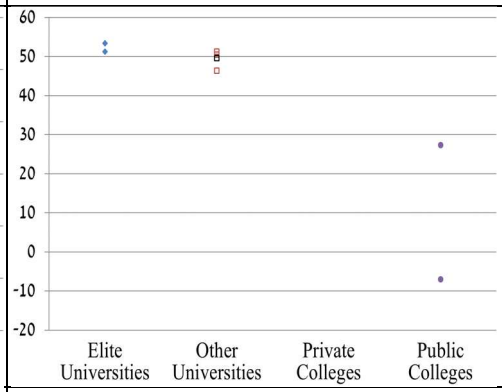
(1) Based on the estimates of the dummy variables for the type of institution, such as those in Table 1, Model 4. The estimations were made separately for each wage year and the number of years that elapsed since then. The figure only presents wage years in which the number of observations were sufficient for an estimation. Empty markers represent a non-significant difference (compared with public colleges) at a level of 10%.
Baseline group: Graduates of public colleges.

Figure A-8. Annual Wage Premium for Undergraduate Degree Holders Compared with Bagrut Matriculation Holders[1,2], by Subject, 2008–15 (percent)

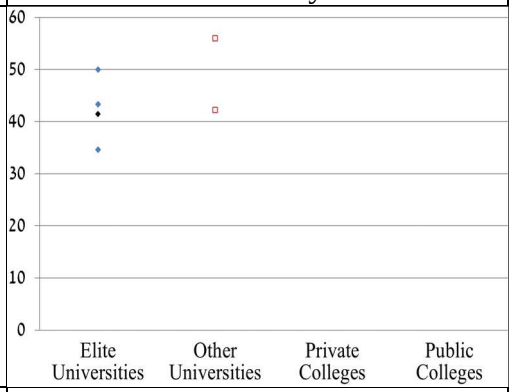
Law



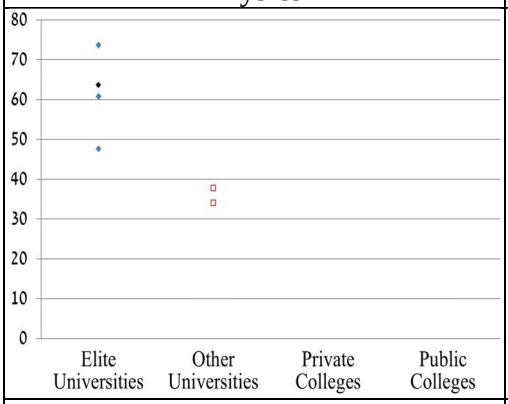
Para-medical



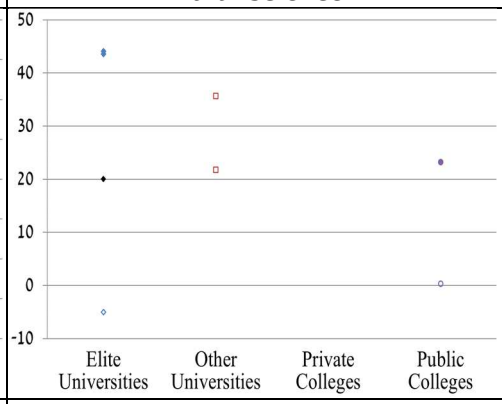
Chemistry



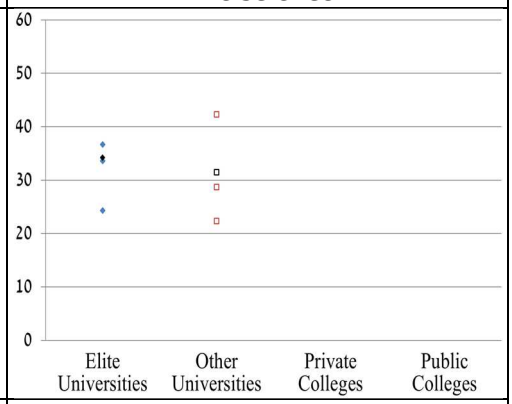
Physics



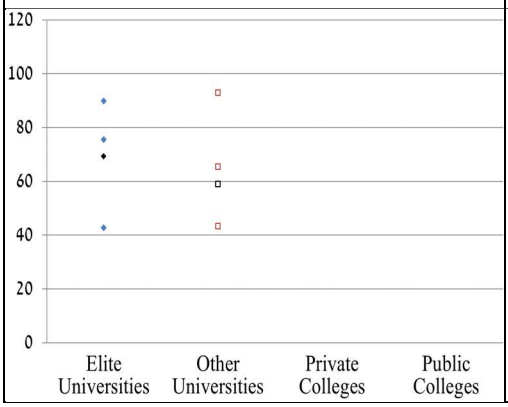
Earth science



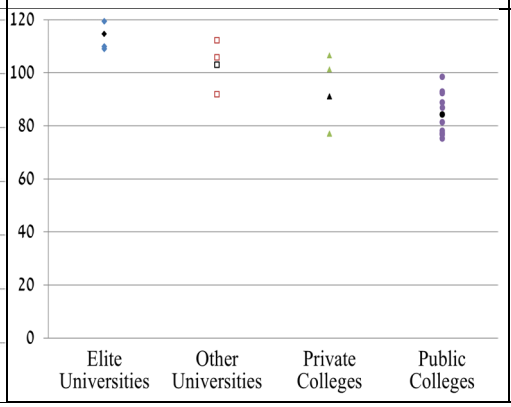
Life science



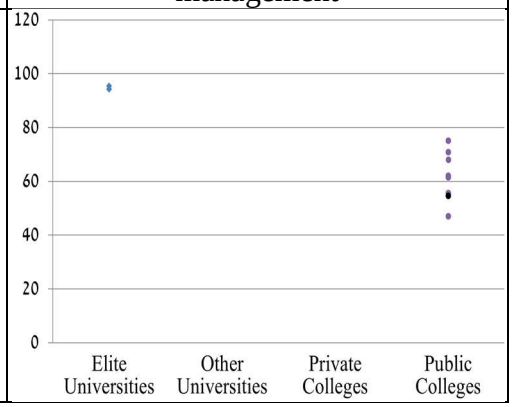
Mathematics

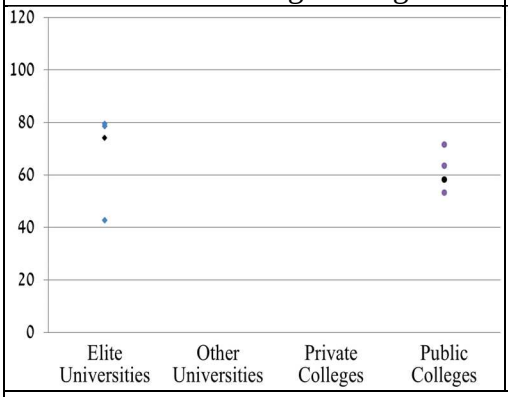
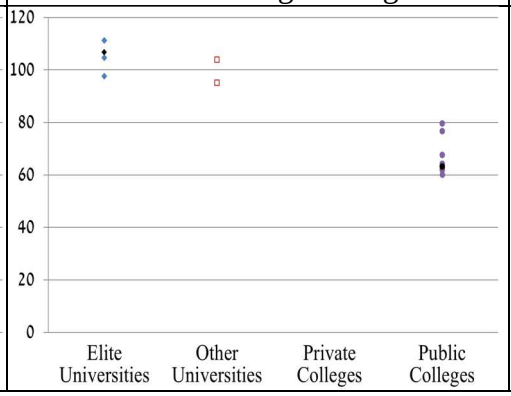


Computer science



Industrial engineering and management



Mechanical engineering	Electrical engineering	
		

Source: Based on Central Bureau of Statistics data processed by the authors.

A pale square and empty diamond and triangle represent a non-significant 10 percent estimate.

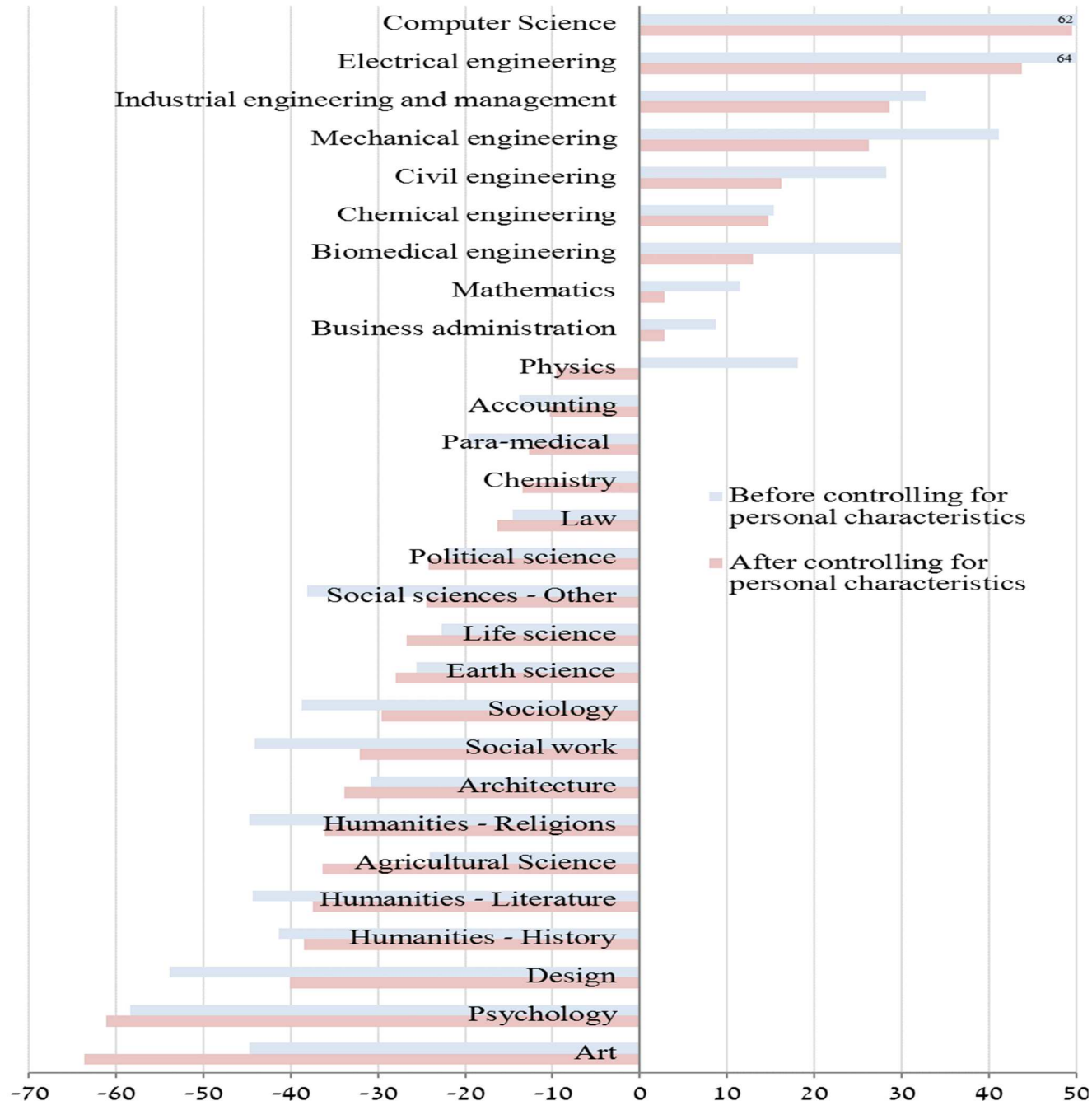
The black markers represent the average for the institution type. We did not present values if only one institution of a given type teaches the subject, and we did not present the average value if only two institutions of a given type teach the subject.

(1) Based on an estimation similar to that in Table 1, Model 4, after the dummy variables for institution type were replaced with dummy variables for the interaction between institution and course of study. The baseline group: Holders of Bagrut matriculation certificates. The estimations were only made if at least 30 individuals completed an undergraduate degree in the subject each year at the institution (therefore only the 4 largest private colleges received values). The average for an institution type is based on an estimation such as the one in Table 1 (Model 4), for each subject separately, with holders of Bagrut matriculation certificates serving as the baseline group.

(2) Includes two groups: (a) Holders of a Bagrut matriculation certificate who did not continue to an academic degree during the study period, and (b) individuals who continued to nonacademic studies (we do not have information about them). In order to assess the size of the bias deriving from the inclusion of Group (b), we processed data based on the 2008 census (PUF file) related to individuals who were 25–34 at the time of the census and were not studying at the time. We found that Group (b) makes up approximately a third of the two groups. A wage equation indicates that the members of Group (b) earned about one-tenth more per year than the members of Group (a). Based on this, we can assess that the differences in the figures are higher by up to 3 percent than what would have been obtained had we included only Bagrut holders in the baseline group.

Figure A-9. Annual Wage Premium on Higher Education by Subject[1]

Compared with Economics[2]**, 2008–15** (percent)



Source: Based on Central Bureau of Statistics data processed by the authors.

All the wage differences after controlling are significant at the 1% level, except for Math: in that case, they are significant at the 10% level.

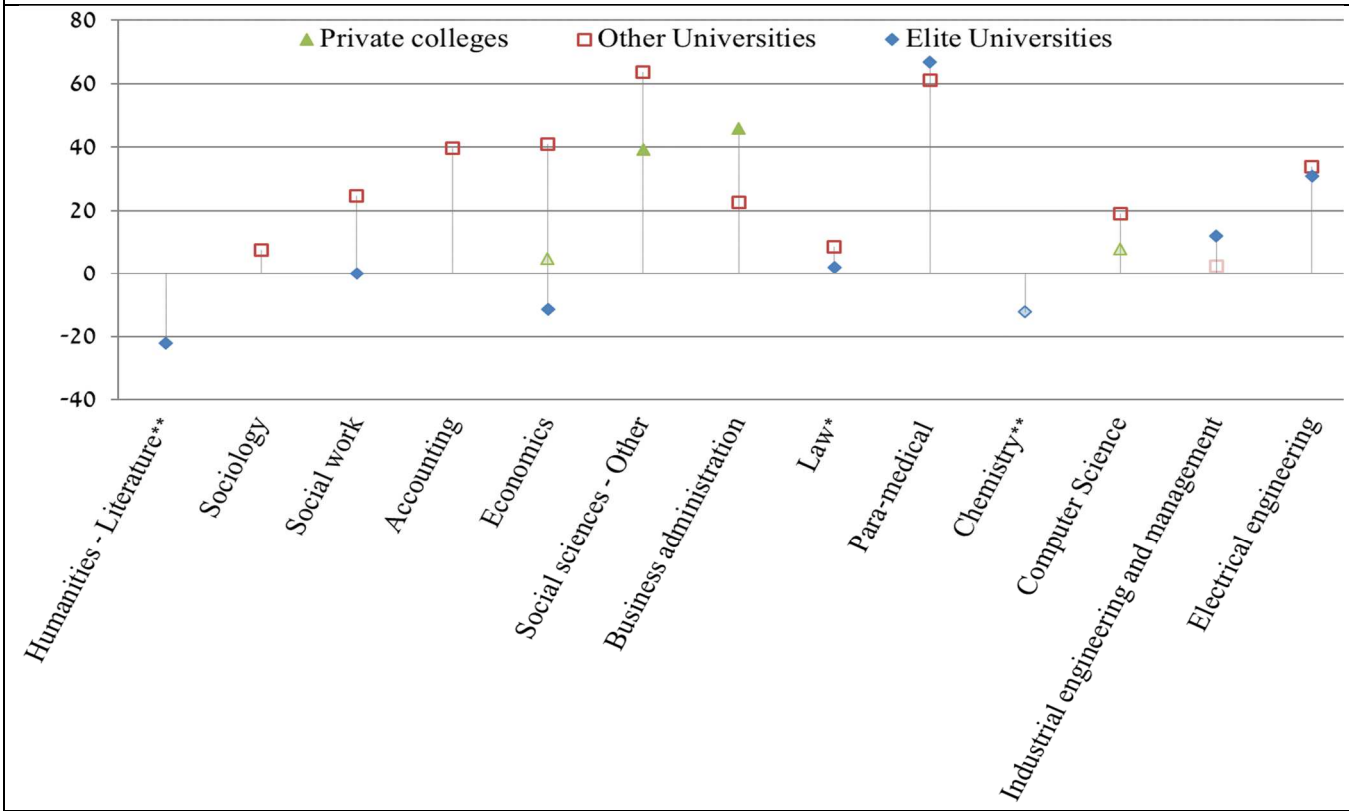
(1) Major subject. The figure presents subjects if at least 30 individuals per year completed an undergraduate or graduate degree in them.

(2) Before controlling—the estimates of the dummy variables for subject, in estimation of the annual wage as a function of those dummy variables and dummy variables for wage years; after controlling—the estimates of the dummy variables for subject in Table 1, Model 4.

Figure A-10. Annual Wage Premium for Undergraduate Degree Holders[1], by Subject[2], 2008–15

(percent)

Based on TSLS estimations[3]



Source: Based on Central Bureau of Statistics data processed by the authors.

* Baseline group: Private colleges, ** Baseline group: Other universities.

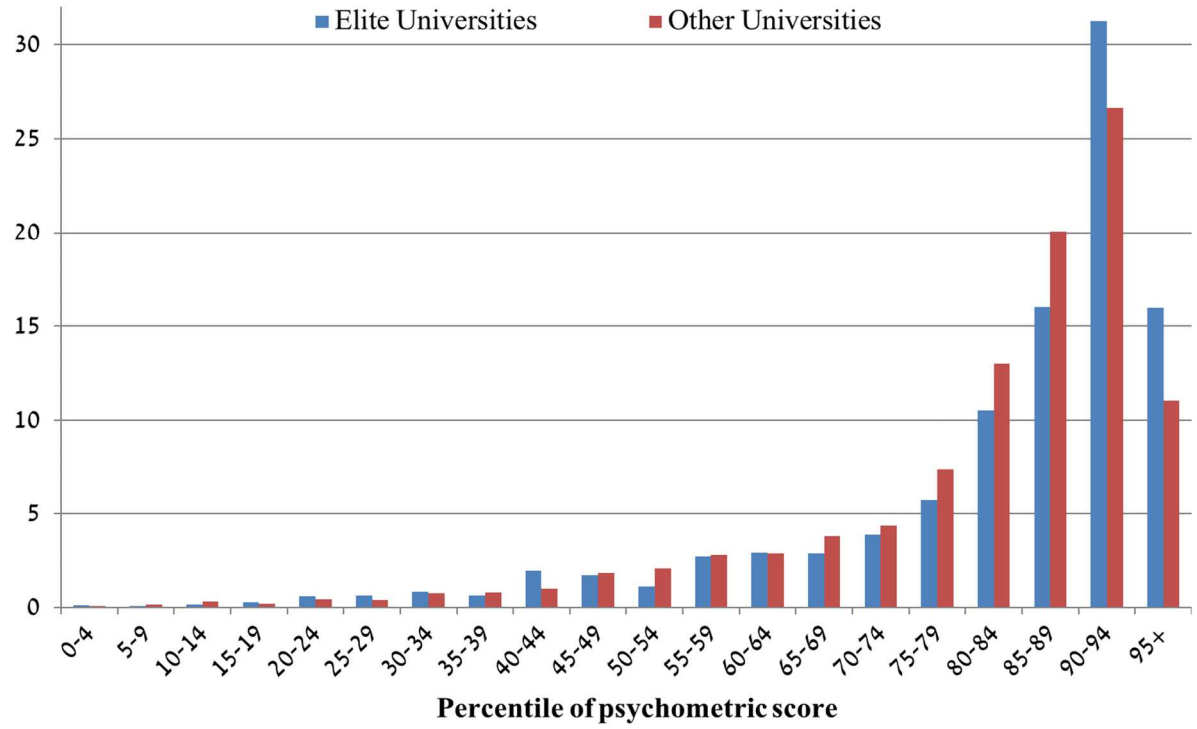
A pale square and empty diamond and triangle represent a non-significant 10 percent estimate.

(1) Includes individuals who studied for a graduate degree in years after the wage year (and who did not study during the wage year).
Baseline group: Graduates of public colleges.

(2) Major subject. The figure presents subject at a specific type of institution if the following two conditions applied: a) the subject is studied in at least two types of institutions, and in each one of them, at least 30 individuals per year completed an undergraduate degree; b) the availability variables in the first stage equation (equation 2) have a Deviance value greater than 40.

(3) Based on the estimates received by the institution-type instrumental variables in the second stage equations (equation 3). For each subject separately.

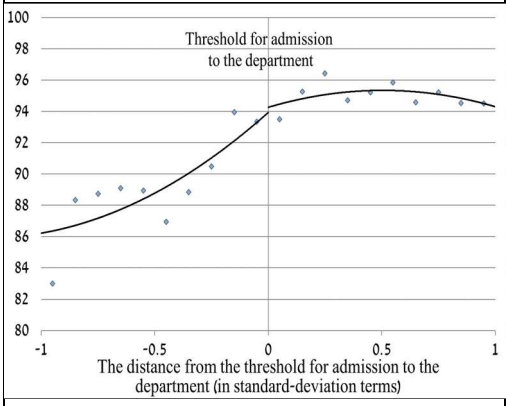
Figure A-11. Distribution of Percentile of Psychometric Test Score among Individuals who Completed an Undergraduate Degree in a University and Registered for One of the Two Types of University (percent)



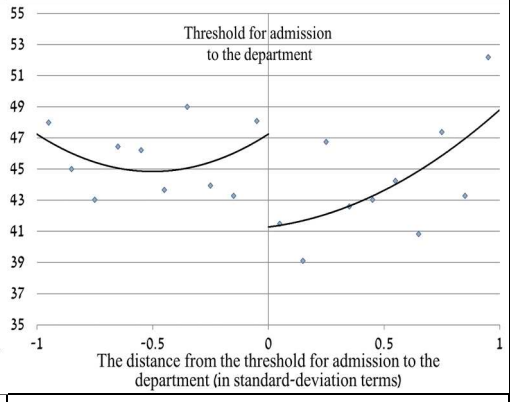
Source: Based on Central Bureau of Statistics data processed by the authors.

Figure A-12. Selected Demographic-Socioeconomic Characteristics of Individuals who Completed an Undergraduate Degree in University and Registered for One of Two Types of University, Relative to the Admission Threshold for Courses of Study at Elite Universities[1]

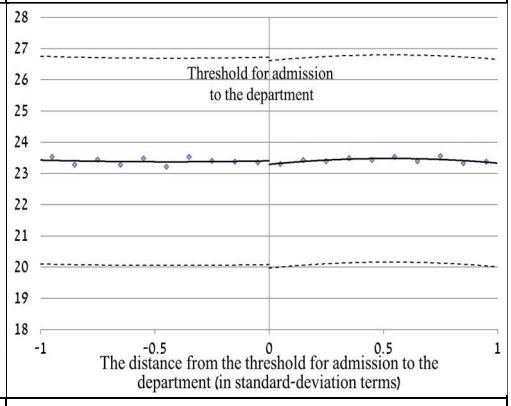
Jews (share, percent)



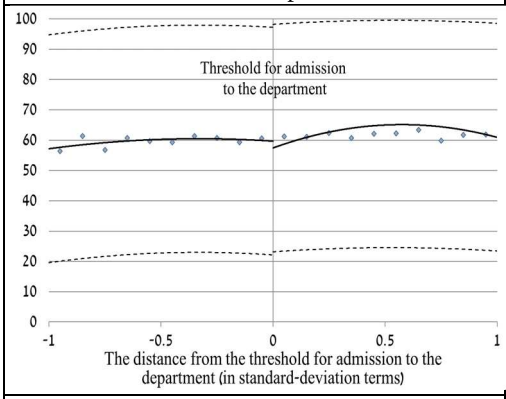
Men (share, percent)



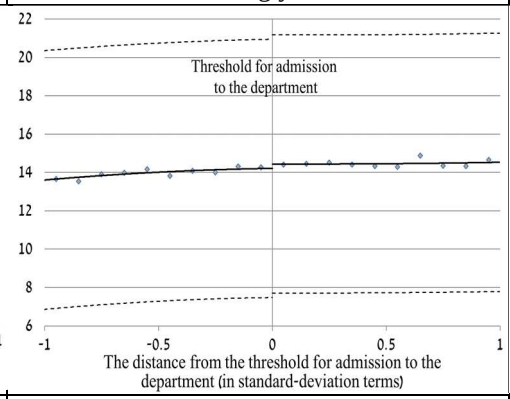
Age[2] (Years)



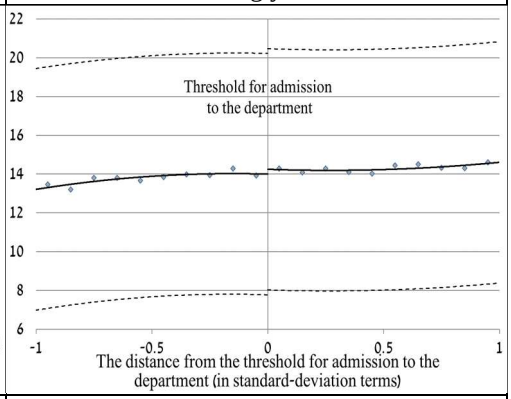
Parents' income percentile[3]



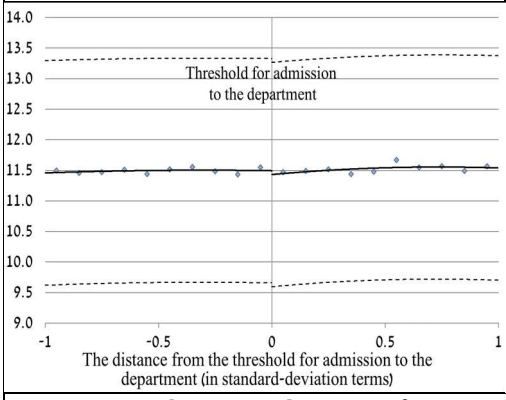
No. of schooling years – father



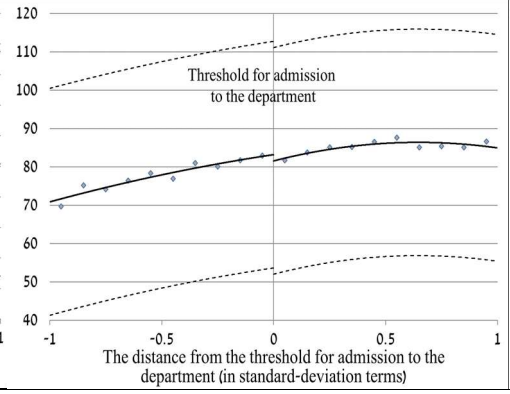
No. of schooling years – mother



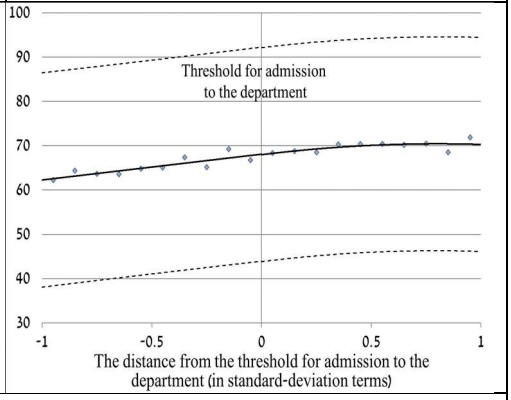
Log annual wage



Percentile of psychometric score



Percentile of average matriculation grade[4]



Source: Based on Central Bureau of Statistics data and processed by the authors.

(1) The continuous lines are derived from the estimates of the following equation:

$$Y_{ijkt} = \alpha_0 + \alpha_1 A_{ijkt} + \alpha_2 f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \alpha_3 A_{ijkt} \times f\left(S_{ijkt} - S_{jkt}^{cutoff}\right) + \varepsilon_{it}$$

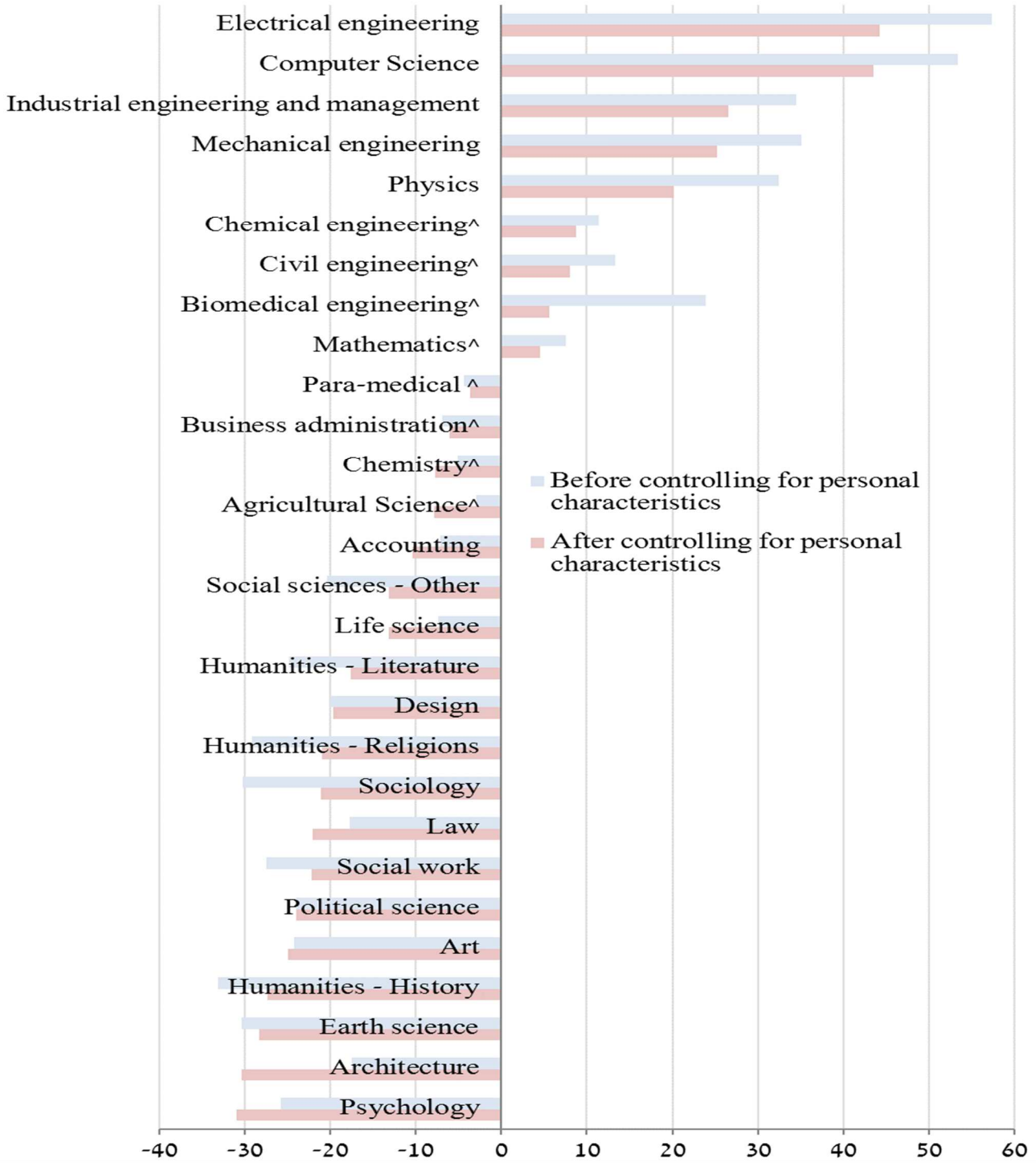
where Y represents the -demographic-socio-economic characteristic and the other variables are identical to those in equation 4. The broken lines represent confidence intervals of 95 percent.

(2) The age when registering for the undergraduate degree.

(3) The gross annual income earned by the parents from employed and self-employed work when their child (the graduate of higher education) turned 24. The percentile was calculated by father's age group and for each year separately (in order to take into account the development of income during the lifecycle).

(4) The average of grade percentiles in courses of study for each test year separately weighted by number of credits in each subject.

Figure A-13. The Hourly Wage Premium on Higher Education by Subject[1,2], Compared with Economics, 2008 (percent)



Source: Based on Central Bureau of Statistics data processed by the authors.

^ The wage difference after controlling is not significant at the 10 percent level.

(1) Major subject. The figure only represents subjects if at least 50 individuals completed a graduate or undergraduate degree in them.

(2) Before controlling—the estimates of the dummy variables for subject in the hourly wage estimation, as a function of those dummy variables; after controlling—the estimates of the dummy variables for subject in Table 7, the "Total" column.