Working Paper in Economics No. 736

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Department of Economics, August 2018

ISSN 1403-2473 (Print)
ISSN 1403-2465 (Online)

UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

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Abstract

This paper uses administrative data from 16 cohorts of the Dutch population to study the relationship between field of study and family outcomes. We first document considerable variation by field of study for a range of family outcomes. To get to causal effects, we use admission lotteries that were conducted in the Netherlands to allocate seats for four substantially oversubscribed studies. We find that field of study matters for partner choice, which for women also implies an effect on partners' earnings. Fertility of women is not affected and evidence for men is mixed, but we find evidence for intergenerational effects on children's education. This means that field of study does not only affect individual labor market outcomes but also causally influences other important dimensions of a person's life.

Keywords: Higher education, Study choice, Returns to education, Assortative matching, Intergenerational mobility.
JEL-codes: I26, J12, J13.

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1 Introduction

A recently emerging literature finds that a large share of the earnings differences between graduates from different fields of study is causal (Altonji et al., 2012; Hastings et al., 2013; Ketel et al., 2016, 2018; Kirkebøen et al., 2016).[1] It is likely that field of study also affects other important outcomes. This paper focusses on family outcomes.

Field of study can influence family outcomes in various ways. First, it may affect partner choice as the chosen field influences the pool of potential partners at an age at which many partnerships are formed. An indication of this is the strong assortative matching by field of study (Eika et al., 2014). Second, because fields of study differ in the impact they have on career opportunities, they may influence decisions on whether and when to form a family. Using Scandinavian data, Hoem et al. (2006) and Lappegård and Rønsen (2005) find that field of study serves as a better predictor of permanent childlessness and first-birth rates than the level of education. Third, through their effects on own earnings and partner quality, field of study may affect the educational achievement of one's children (e.g. Black and Devereux, 2011; Holmlund et al., 2011).

If the chosen field of study has effects beyond labor market outcomes, prospective students may be aware of this and take these effects into account when making their field of study choices. Wiswall and Zafar (2016) present evidence that students at an elite university in the US indeed believe that the probability of being married, spousal education and earnings, and fertility depend on the major they choose. Moreover, these authors find that the perceived family returns help explain students' human capital choices.

Whether differences in family outcomes by field of study are truly causal or are merely due to self selection, is an open question. While the above mentioned channels are plausible, it cannot be ruled out that people who are anyhow less inclined to have a family, opt for a field of study where the fraction of people who stay single, is high. Even Wiswall and Zafar's finding that students perceive that family outcomes depend on the choice of major, does not prove causality because only the realization for the actually chosen major is observed.

To make progress on this challenging issue, this paper uses admission lotteries for university studies in the Netherlands to estimate causal effects of field of study on family outcomes. The four undergraduate programs for which there have been admission lotteries with sufficient numbers of admitted and rejected applicants are medicine, dentistry, veterinary medicine and international business studies. The effects that we estimate are based on the contrast between family outcomes of applicants who won the admission lottery and completed their preferred field of study and family outcomes of applicants who lost the lottery and ended up in their next-best field. The family outcomes that we consider are: having a partner, quality of the partner (measured as having a partner with a college degree and having a partner with a college degree from the same field), own earnings, partner earnings and household earnings, number of

[1] Kirkebøen et al. (2016) and Hastings et al. (2013) exploit variation due to admission cutoffs in Norway and Chile respectively, and find that for many fields of study the payoffs rival the college wage premium. Ketel et al. (2016) and Ketel et al. (2018) exploit variation caused by admission lotteries for medicine and dentistry in the Netherlands and find substantial earnings returns to these fields of study relative to applicants' next-best fields.

children and quality of children (measured as children entering the highest track in secondary school).

Our key finding is that fields of study have a causal impact on family outcomes. For each field of study with admission lotteries, there are family outcomes that differ significantly between lottery winners and lottery losers. And likewise, for each family outcome there are fields of study with admission lotteries, where outcomes differ significantly between lottery winners and losers.

More specifically, we find that: i) men who completed medicine are more likely to have a partner and to have a partner with a college degree than men who did not study medicine because they lost the lottery; ii) both men and women who win the admission lottery are more likely to have a partner from the same field of study than lottery losers; iii) women who completed medicine have a partner with higher earnings than women who lost the medicine lottery; iv) men who completed medicine have more children than their counterparts; v) the children of men who completed medicine and of women who completed international business are more likely to enter the highest track in secondary school than the children of their counterparts. The finding that fields of study matter for family outcomes is further strengthened by the result that the effects of winning the lottery for medicine depend on what the next-best field of study is (medicine is the only field with admission lotteries with enough observations to analyze this).

The analysis based on admission lotteries pertains to four fields of study. To put these results in perspective, we start in Section 2 with a descriptive analysis using administrative data from 16 birth cohorts (1965-1980) of the Dutch population. This analysis documents considerable differences in family outcomes between fields of study among college graduates. Probabilities to have a partner vary by up to 15 percentage points between different fields and the degree of assortative matching by field of study is high. Graduates from different fields of study have partners with on average rather different earnings. Also fertility and even educational outcomes of their children differ substantially between graduates from different fields of study.

After the descriptive section, Section 3 provides details about the admission lotteries, Section 4 introduces the empirical approach and Section 5 describes the data. Section 6 presents the estimates of the causal effects of fields of study on family outcomes. Section 7 presents results that differentiate the effects of completing medicine by next-best fields. Section 8 summarizes and concludes.

2 Family outcomes by field of study

This section presents descriptive results of family outcomes by field of study. It first shows that men and women concentrate in different fields, and that this has not changed over time. It next documents high rates of assortative matching by field of study. It further documents substantial differences in own earnings, partner earnings and household earnings, as well as in fertility and the educational achievement of the children between graduates from different fields of study.

The results in this section are based on administrative data from Statistics Netherlands (CBS) which contain information from municipalities, tax authorities, education registries and social insurance administrations of all inhabitants of the Netherlands who are registered at a municipality in a given year. The data include individual-level information on family formation and composition (cohabitation, marital status, children), educational attainment, income from various sources (employment, self-employment, income from abroad and from other sources) and household identifiers to link family members. Information on family outcomes is available until 2015 and earnings data cover the years 1999 to 2015.

We restrict our sample to individuals born between 1965 and 1980 (4.3 million observations) and focus on outcomes at age 35. At that age, earnings provide a good approximation of life-cycle earnings and most family formation has taken place. Although fertility is not completed at age 35, potential differences in the timing and number of children by field are visible. The focus of our analysis is on college graduates[2] (1.1 million observations) as we are primarily interested in differences in family outcomes by field of study. We initially distinguish three pooled birth cohorts (1965-1970, 1971-1975 and 1976-1980).

For level of education, we distinguish between college and less than college education, while for field of education we consider only college graduates and sort individuals into twelve fields of study based on the International Standard Classification of Education (ISCED). The twelve fields are: 1) Education, 2) Humanities, Arts and Journalism, 3) Social sciences, 4) Economics, 5) Business, 6) Law, 7) Science, Mathematics and Computing, 8) Engineering, Manufacturing and Construction, 9) Agriculture and Veterinary, 10) Health, 11) Social services and 12) Services. Students in the Netherlands choose their field of study as soon as they enter college, unlike, for example, in the US where students specialize later. Tracking by academic level starts at the beginning of secondary education at the age of 12.

College graduates by field of study

College enrollment increased considerably from the oldest cohort to the youngest cohort included in this study. While only about 15% of men and women born in 1965 obtained a college degree, this increased to approximately 28% of men and 35% of women in the 1980 birth cohort.

Figure 1 shows the distribution of fields of study among college graduates by gender and (pooled) birth cohorts. The distribution over fields differs substantially between men and women, but is fairly constant across cohorts. The highest fraction of men graduated in Business or Engineering, Manufacturing and Construction, while less than 3% of the graduates of each birth cohort studied Social Services or Agriculture and Veterinary. Women most often study Education, Business, and Health, while Economics, and Agriculture and Veterinary are the least popular fields. The gender differences in the choice of study fields in the Netherlands are comparable to those in other OECD countries (OECD, 2016). Since there are only minor

[2] In the Netherlands, individuals can obtain a degree from either a research university ("Wetenschappelijk Onderwijs", WO) or a professional college ("Hoger Beroepsonderwijs", HBO). We refer to the combined group as "college graduates".

differences between cohorts, we will not report about this dimension from here on.[3]

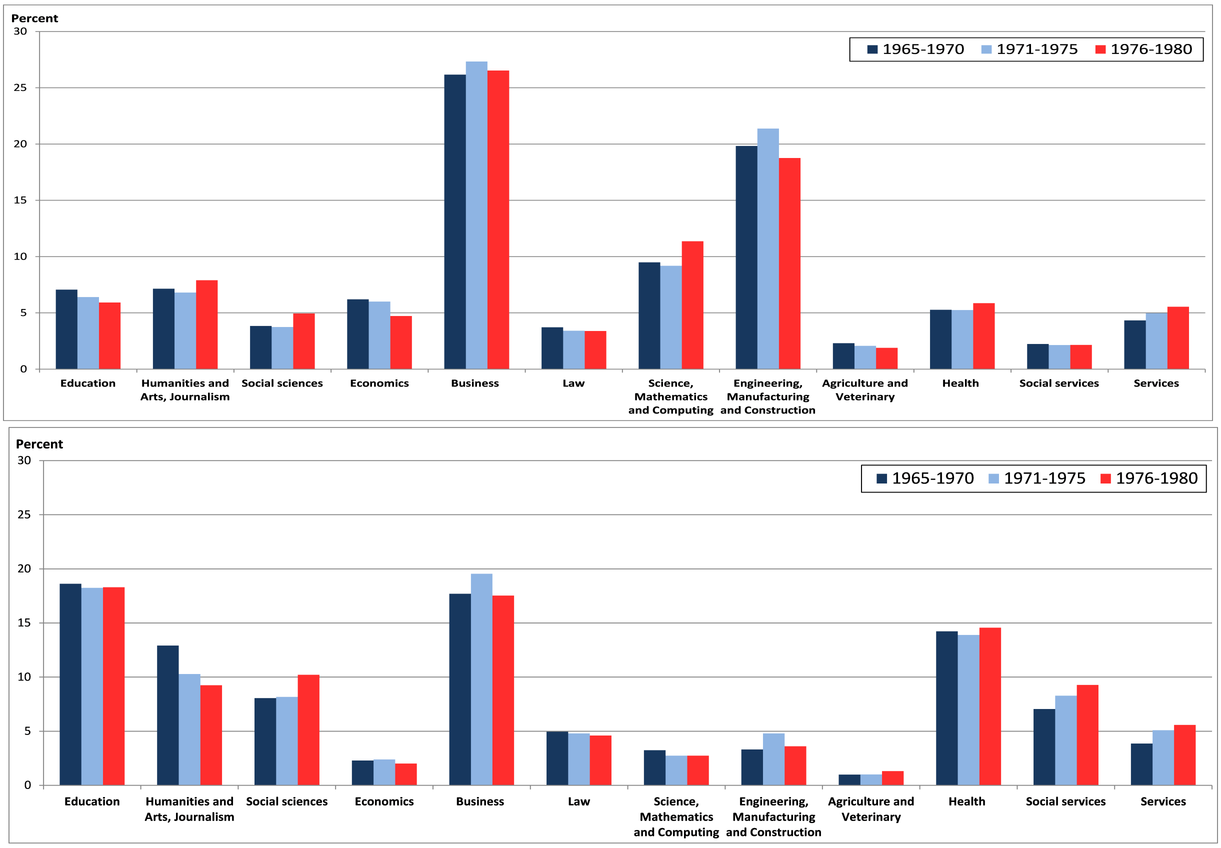

Figure 1: Fields of study of men (top panel) and women (bottom panel) by birth cohort

Having a partner

The probability to have a partner (married or cohabiting) at age 35 is higher for college graduates than for others, with a larger difference for men (76% vs. 64%) than for women (78% vs. 74%). Figure 2 shows the probability to have a partner at age 35 by field of study and gender.[4] While about 80% of men and women with a degree in Education or Health have a partner at age 35, less than 65% (70%) of male (female) graduates in Humanities, Arts and Journalism do. Women are in general more likely to have a partner at age 35 than men, but the differences by field are relatively similar for men and women.[5]

Educational assortative matching

To examine patterns of educational assortative matching, we contrast observed patterns with the distributions that would occur under random matching. To calculate the share of men in a

[3] We also looked at the subsequent family outcomes separately for the birth cohorts 1965-1970, 1971-1975 and 1976-1980, but find only negligible changes over time (see Appendix A.2).

[4] Partners also include same-sex partners.

[5] Marriage rates at age 35 are roughly 20 to 25 percentage points lower than partnership rates, but vary by gender and level of education in a similar way, see Figure A1 in the Appendix. Divorce rates by age 35 are lower for college-educated individuals (women: 6%, men: 3%) than for individuals with lower education (women: 11%, men: 7%). As shown in Figure A2, they also differ strongly by field of study.

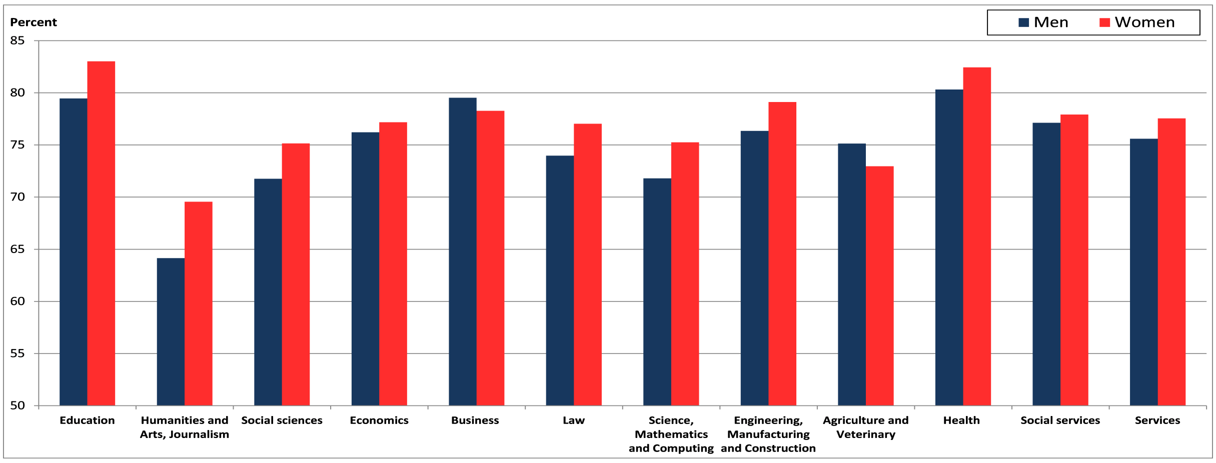

Figure 2: Probability to have a partner at age 35 by field of study

partnership where both partners are college educated under random matching, we multiply the share of college-educated men in their birth cohort with the share of women with a college degree in the birth cohort of the men's actual partner. Taking the mean of the resulting probabilities gives men's likelihood under random matching of both partners having a college degree. The shares for women are computed analogously. On average, 16% of men and 14% of women are in a partnership where both are college-educated, which are around two and a half times as large as the shares that would result under random matching.

Next, we focus on couples where both partners completed college. In addition to displaying the actual shares of college-educated couples with a diploma from the same field, we again calculate the shares that would result under random matching. For men (women) we multiply an indicator for having a degree from the same field of study with the share of women (men) in men's (women's) own field in the birth cohort of their actual partner. Taking the mean of the resulting probabilities gives the likelihood under random matching of both college-educated partners having a diploma from the same field. The share of college-educated couples with a degree from the same field is around 24% for both men and women, while under random matching slightly less than 10% of the graduates would have a partner from the same field.

To compare assortative matching between fields, we need a metric that takes differences in marginal distributions into account. While the sex that is in the minority in a given field can in principle achieve an assortative matching rate of 100%, the maximum attainable rate for members of the sex that forms the majority in a given field is bounded by the "supply" of the other sex. As a measure that is invariant to the supply limitation, Liu and Lu (2006) propose to divide the difference between the actual share and the share under random matching by the difference between the maximum attainable share and the share under random matching. We refer to this measure as the "corrected" share. Figure 3 shows the actual and random shares and Figure 4 the corrected shares of assortative matching by field of study separately for men and women.

For men the actual share with a partner from the same field of study is highest in Education and in Health, while the corrected share is highest in Health and in Engineering, Manufacturing and Construction. For women the actual share is highest in Engineering, Manufacturing and

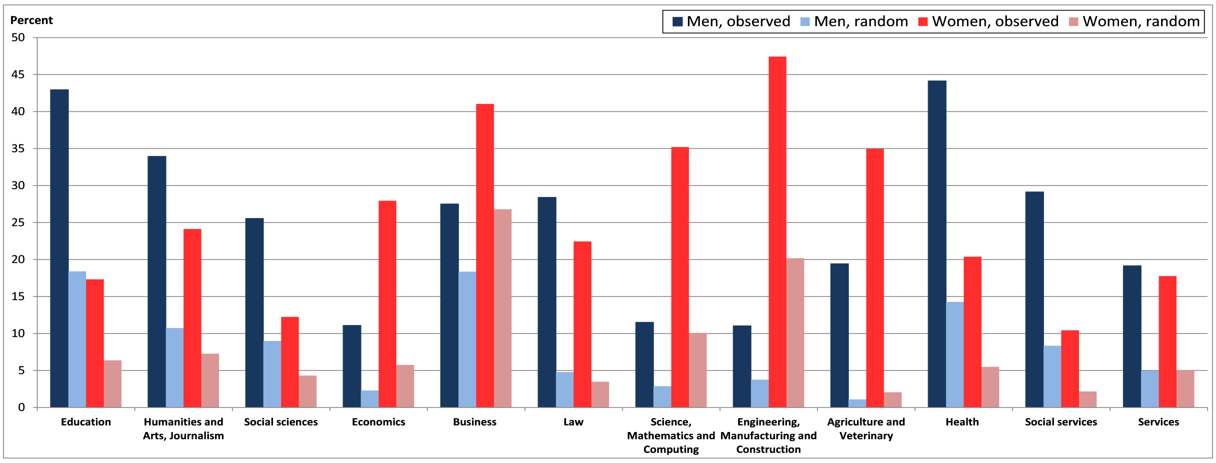

Figure 3: Shares of graduates with a partner from the same field

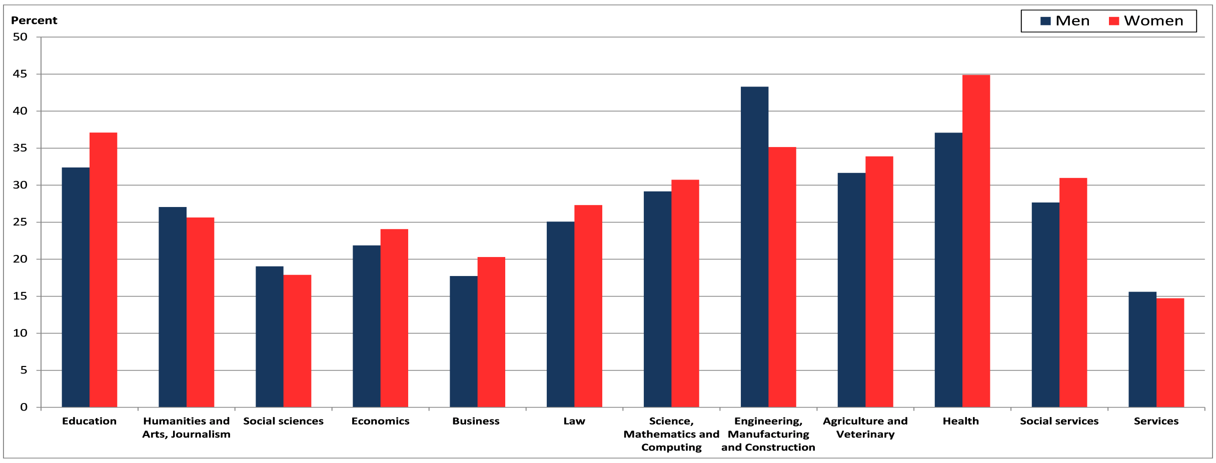

Figure 4: Shares of graduates with a partner from the same field (applying Liu and Lu (2006) correction)

Construction and in Business, while the corrected share is highest in Health and in Education. Social Sciences, Business and Services are fields with low corrected shares of assortative matching, both for men and for women.

Earnings

Individual earnings differ substantially by level of education and by gender. At age 35, men earn on average 51,475 euros per year with a college degree and 29,272 euros without.[6] For women these amounts are 31,923 and 13,965 euros. When looking at household earnings, the gender differences largely disappear. Women's households earn slightly more than the respective households of men with the same level of education, i.e. household earnings are 74,060 vs. 72,505 for college-educated and 43,903 vs. 40,231 for non-college educated women and men. This pattern is likely to reflect the high degree of assortative matching documented and women's tendency to "marry up" in terms of education, age and income (Bertrand et al., 2015).

[6]Annual earnings are measured as the sum of before-tax income from employment, income from self-employment, income from abroad, and other income from labor and are converted to 2015 euros. Household earnings are calculated including single households.

The top panel of Figure 5 shows that individual earnings are much higher for graduates from some fields (Economics, Law, Health) than for graduates from other fields (Humanities, Arts and Journalism, Social services). In each field individual earnings are higher for men than for women. The middle panel shows that partner's earnings follows the same pattern by field and the reverse pattern by gender: women who studied Economics or Law are with partners who earn substantially more than the partners of women in Social services. The bottom panel combines the two graphs (together with partner formation) and shows that the differences in household income between graduates from different fields are inflated, whereas the differences between men and women disappear.[7]

Figure 5: Average individual (top panel), partner (middle panel), and household (bottom panel) earnings at age 35 by field of study

[7]The fact that in most fields household earnings are higher for women than for men reflects that women typically form a partnership with men that are somewhat older.

Fertility patterns

While fertility, measured at age 35, hardly differs between college graduates and others[8], variation by field of study is substantial. Figure 6 shows average numbers of children at age 35 by field of study and gender. Women of all fields have on average more children at age 35 than men from the same field. Both male and female graduates in Education have the most children, while graduates in Humanities, Arts and Journalism, the field with the lowest average (household) earnings, have the fewest.[9] In terms of field of study, women's average number of children varies somewhat less than men's. The average number of children tends to be higher in fields where a larger fraction of the graduates have a partner.

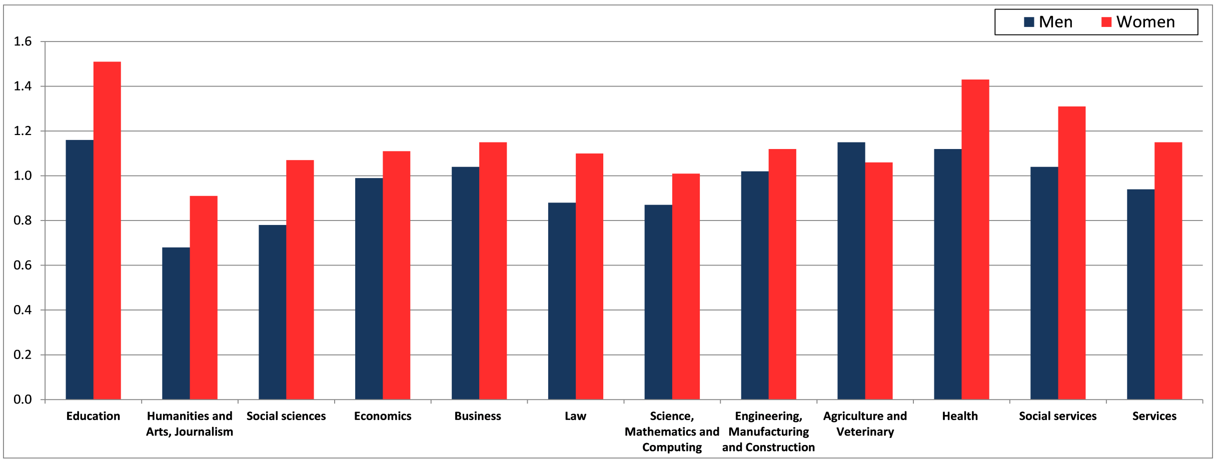

Figure 6: Average number of children at age 35 by field of study

Intergenerational effects

To examine the educational success of the children of graduates from different fields of study, we focus on children that are of secondary-school age and measure which share of them entered the highest academic track.[10] Slightly more than 20% of each cohort from the general population enters this track. Figure 7 shows that this share is higher among the children of parents with a college degree. It also shows that there is substantial variation across fields. Of the children of men who studied Social services about 25% enter the highest academic track, while this share is about 55% among the children of women who studied Economics.

3 The admission lotteries

The previous section documented large differences in family outcomes by field of study. Whether these differences are causally related to fields of study or are merely due to selection, is unclear.

[8] Thirty-five year old college-educated women have on average 1.2 children and lower educated women 1.4 children. Men have on average one child at age 35, irrespective of their level of education

[9] By age 35, fertility is not yet completed, but the differences by field of study in average number of children at age 40 of the birth cohorts 1965 to 1975 show a qualitatively similar picture as the one in Figure 6 (results not reported).

[10] Dutch schoolchildren are tracked into different levels at the age of 11 or 12 when they enter secondary school. The academic track is the highest track.

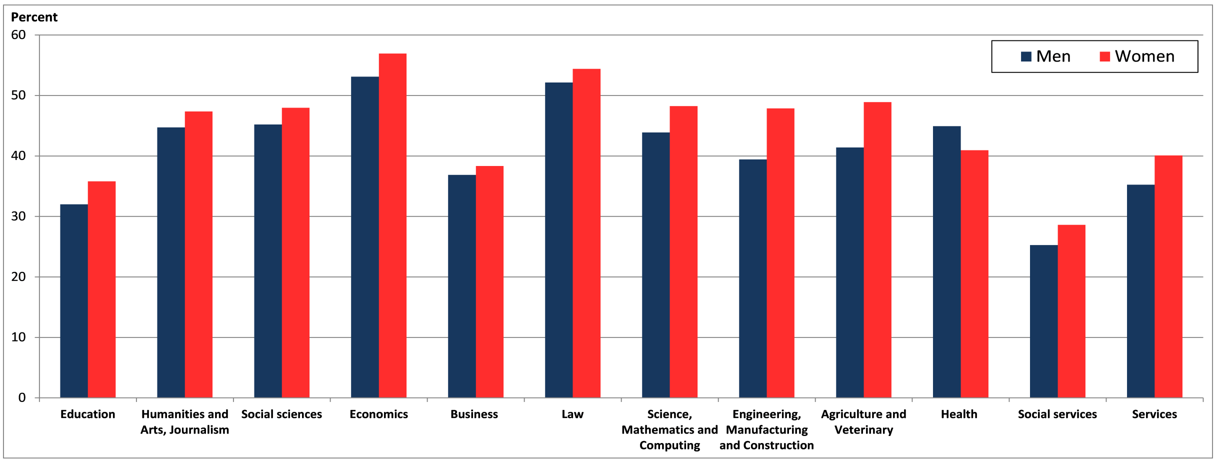

Figure 7: Fraction of secondary-school children that entered academic track VWO

We now turn to fields of study that have used admission lotteries, to examine whether fields of study have a causal influence on family outcomes.

Secondary school graduates in the Netherlands who completed the academic track are eligible for university studies in all fields of study and institutions. For the large majority of fields, universities have to accept all applicants but some fields have quotas that limit the number of students that are admitted. The quotas were introduced in response to the drastically increasing number of potential students at the end of the 1960s which exceeded the number of study places available (see Goudappel (1999) for details on the reasons for introducing quotas).

Until the year 1999, students who applied to a study with a quota were admitted on the basis of the results from a (nationwide) centralized lottery.[11] Studies that had admission lotteries are medicine, dentistry, veterinary medicine and international business. Rejected applicants are allowed to reapply in the next year, and until 1999 they could do this as often as they wanted.[12] We observe that large fractions of rejected first-time applicants reapply at least once.

Lottery participants are allocated to lottery categories. Those with a higher GPA on their high-school exams have a higher chance of being admitted, i.e. they receive a higher weight in the lottery (Table 1).[13] Applicants in lottery category A with a GPA of at least 8.5 receive a weight of 2.00, whereas applicants with a GPA between 6 and 6.5 are assigned to category F with a weight of 0.67. The last category "Other" includes applicants who did not take the Dutch secondary school exams, e.g. foreign students, and will be excluded from the analysis. The majority of students are allocated to categories D to F. The number of available places per lottery category is determined such that for the total number of available places divided by the

[11] From 2000 onwards, studies with quotas have been allowed to admit (initially) at most 50 percent of the students using their own criteria. Universities have made increasing use of this and by now, the admission lotteries have been completely abolished. Selection is often based on motivation and previous experience. For this reason we restrict our analysis to students who first applied to a lottery study before this change

[12] In our data, the maximum number of applications of one individual is nine. Since 1999, the maximum number of applications is limited to three.

[13] Graduating from secondary school requires an exam in seven subjects including Dutch and English. Applicants for medicine, dentistry and veterinary medicine should also have passed biology, chemistry, physics and math. Once the exam is passed it cannot be retaken. Applicants can thus not retake the exam in order to end up in a higher lottery category.

Table 1: Lottery categories

Category	GPA	Weight	Share			
			Medicine	Dentistry	Vet. medicine	Int. business
A	$8.5 \leq$ GPA ≤ 10	2.00	1.7%	0.3%	1.0%	0.7%
B	$8.0 \leq$ GPA < 8.5	1.50	5.4%	1.9%	2.8%	2.9%
C	$7.5 \leq$ GPA < 8.0	1.25	8.6%	3.4%	6.4%	6.4%
D	$7.0 \leq$ GPA < 7.5	1.00	20.8%	13.8%	18.7%	19.2%
E	$6.5 \leq$ GPA < 7.0	0.80	22.1%	21.4%	24.7%	24.4%
F	$6.0 \leq$ GPA < 6.5	0.67	29.9%	39.8%	33.3%	36.1%
Other	–	1.00	11.5%	19.5%	13.2%	10.4%

number of applicants in a category, the weights given in Table 1 hold.

4 Empirical approach

We are interested in the effects of completing a study with an admission lottery on family outcomes. We focus on outcomes measured at age 35. We assume a linear relationship between outcome variable Y_{it} of individual i observed at age 35 in year t, and degree completion (C_i):

$$Y_{it} = \alpha_t + \delta C_i + X_i\beta + LC_i + U_{it} \tag{1}$$

The effects of degree completion on outcomes are captured by δ, our parameters of interest. The vector of controls X_i includes individual's age at first lottery participation and an indicator for non-western origin.[14] The interaction term between lottery category and year of first participation, LC_i, controls for the fact that individuals' chances of being admitted are only identical conditional on lottery year and category. Lastly, α_t are fixed effects for the year in which the respective outcome is observed and U_{it} is an individual-specific error term.

Compliance with the result of the first lottery is imperfect for all four study programs (see Section 5). Not all winners of the first lottery enroll in the respective program, while some drop out before completing their degree. The fraction of lottery losers who (successfully) reapply in subsequent years differs by program, but ultimately a substantial fraction of first-time lottery losers completes the lottery study program. As degree completion C_i is endogenous, a simple OLS estimate of δ would be biased, so that we use an instrumental variable approach. The result of an individual's first lottery (LR_{1i}) serves as an instrument for degree completion (C_i):

$$C_i = \kappa_t + \lambda LR_{1i} + X_i\theta + LC_i + V_{it} \tag{2}$$

The identifying assumption is that conditional on X_i and LC_i, the result of the first lottery is mean independent of U_{it}: $E[U_{it}|X_i, LC_i, LR_{1i}] = E[U_{it}|X_i, LC_i]$. Since program admission

[14] When analyzing the effect of completing a specific lottery study program on children's educational achievement we also include the child's gender, child's age at secondary-school enrollment and fixed effects for the year of enrollment in X_i.

is random conditional on lottery category and year of first participation, the mean conditional independence assumption holds for the first lottery where selective reapplication has not taken place yet. The parameter λ describes the fraction of compliers in the sample, so that δ in equation (1) is to be interpreted as Local Average Treatment Effect (LATE). This describes the effect of graduating for individuals for whom the result of the first lottery determines whether they complete the respective study program.

5 Data

Data sources and sample

We use administrative data from different registers available at Statistics Netherlands. The key register is the one on the admission lotteries. This register contains information on all applicants for medicine, dentistry, veterinary medicine, and international business, their lottery category and the outcomes of all lotteries. We also have information on actual study choices of all applicants and their study progress.

Lottery information is available for the years 1987 to 2004. To make sure that we observe first-time applicants, we exclude applicants who participated in 1987 since we have no information about possible participation in 1986, and we exclude applicants older than 20 when we observe them applying for the first time. Because the lottery system was gradually abandoned after 1999, we also exclude individuals applying for the first time after that year. Finally, we restrict the sample to applicants born before 1981 as for the later-born cohorts we do not observe our outcomes at age 35.[15]

Summary statistics

Tables A1 to A4 in the Appendix present the balancing of pre-treatment individual characteristics between winners and losers of their first lottery for medicine, dentistry, veterinary medicine and international business, respectively. For each lottery category we show the sample means of the individual characteristics and report the p-value for equality obtained from regressing winning the lottery on this characteristic and year of lottery fixed effects. While some of the differences are statistically significant, these differences pertain to categories with few observations, so that overall we conclude that the samples of lottery winners and losers are balanced.

Table 2 reports summary statistics on study enrollment and completion separately by gender and admission status for the four lottery study programs. First, around 93% of the applicants admitted to medicine, dentistry and veterinary medicine in their first lottery actually enroll in the program, while these rates are slightly lower for international business. Among the losers of the first lottery, between 11% and 43% of men and 10% to 48% of women enroll in the

[15] We also drop applicants from lottery category A and applicants for dentistry in 1988 to 1992 and for international business in 1993, 1994 and 1999 because almost no one from this category and study-years lost the lottery.

Table 2: Sample description by gender and outcome of the first lottery application

	Men		Women	
	Winners	Losers	Winners	Losers
I. Medicine				
Enrolled in medicine	94.6%	42.7%	93.4%	47.7%
Completion of medicine	81.2%	37.1%	83.6%	44.1%
Enrolled in study program in NL	99.6%	95.6%	99.5%	96.6%
Completion of study program in NL	93.5%	88.9%	97.0 %	94.4%
N	4,716	5,524	6,507	7,565
II. Dentistry				
Enrolled in dentistry	91.1%	39.6%	91.5%	41.5%
Completion of dentistry	76.5%	33.8%	81.3%	38.1%
Enrolled in study program in NL	99.3%	95.9%	99.5%	98.6%
Completion of study program in NL	95.9%	93.0%	98.5%	96.6%
N	417	488	412	494
III. Veterinary medicine				
Enrolled in veterinary medicine	93.5%	22.9%	93.3%	28.2%
Completion of veterinary medicine	74.8%	20.1%	80.7%	24.8%
Enrolled in study program in NL	98.8%	88.8%	99.4%	90.1%
Completion of study program in NL	93.5%	77.9%	96.6%	82.6%
N	337	939	653	1,838
IV. International business				
Enrolled in international business	86.9%	11.4%	83.3%	10.2%
Completion of international business	54.5%	6.4%	60.0%	6.3%
Enrolled in study program in NL	99.0%	98.1%	99.3%	97.0%
Completion of study program in NL	84.2%	80.8%	92.1%	88.2%
N	3,001	2,492	1,396	1,091

respective program after having won a subsequent lottery. Almost all lottery winners enroll in a study program in the Netherlands, while between 89% and 98% of the losers do so. The shares of lottery winners who complete the program are lowest for international business (55% of men and 60% of women) and highest for medicine (81% of men and 84% of women). Between 84% and 98% of lottery winners and between 78% and 97% of lottery losers complete a study program in the Netherlands.

Table 3 shows for each of the lottery studies the five fields of study that are most often chosen by lottery losers who end up in their next-best study. Many losers enroll in programs that belong to the same educational field as the lottery study program they applied for.

Table 4 presents summary statistics for the outcome variables by program, gender and admission status. Between 47% and 66% of the lottery applicants have a partner with a college

Table 3: Most popular study fields of lottery losers enrolling in other programs

Men		Women	
I. Medicine			
Health	37.0%	Health	27.4%
Science, Mathematics, Computing	14.6%	Social sciences	17.3%
Business	13.0%	Education	9.5%
Engineering, Manufacturing, Construction	10.3%	Law	7.7%
Law	9.6%	Science, Mathematics, Computing	7.4%
II. Dentistry			
Health	30.9%	Health	39.1%
Business	19.4%	Law	11.9%
Engineering, Manufacturing, Construction	14.5%	Education	9.6%
Science, Mathematics, Computing	10.2%	Social sciences	8.9%
Law	6.9%	Business	8.9%
III. Veterinary medicine			
Agriculture, Veterinary	23.4%	Health	21.7%
Science, Mathematics, Computing	17.2%	Agriculture, Veterinary	18.6%
Health	14.9%	Science, Mathematics, Computing	17.1%
Engineering, Manufacturing, Construction	13.6%	Education	9.7%
Business	8.4%	Social sciences	8.5%
IV. International business			
Economics	38.7%	Business	29.6%
Business	30.3%	Economics	27.4%
Law	11.1%	Law	15.4%
Social sciences	5.0%	Social sciences	9.7%
Humanities, Arts, Journalism	3.9%	Humanities, Arts, Journalism	5.1%

degree at age 35, whereby this fraction tends to be higher among lottery winners than among losers. The winners of all four lottery study programs more frequently have a partner who obtained his/her highest qualification in the same ISCED-classified educational field. Admitted first-time applicants also more often have a partner who graduated from the respective lottery study program. Average annual real earnings at age 35 tend to be higher for lottery winners than for lottery losers. The partners of male lottery losers tend to earn more than those of male lottery winners, while the reverse holds for female lottery applicants. Overall, the households of lottery winners tend to have higher average incomes than the households of lottery losers.[16] The fraction of medicine and international business applicants' children who enroll in the highest track of Dutch secondary education also partly differs between lottery winners and losers.[17]

[16] The lottery applicants' and their partners' earnings do not add up to the respective average household income as the latter also includes single households.

[17] The number of children of dentistry and veterinary medicine applicants is too small for a meaningful analysis of intergenerational effects.

Table 4: Summary statistics on family outcomes by applicants' admission status and gender

	Men		Women	
	Winners	Losers	Winners	Losers
I. Medicine				
Partner at age 35	81.1%	75.8%	81.4%	79.8%
Partner college degree	66.2%	60.6%	63.5%	60.4%
Partner same educational field	31.4%	22.6%	20.6%	16.2%
Partner medical degree	22.6%	13.1%	17.5%	10.0%
Number of children at age 35	1.25	1.08	1.41	1.37
Real (2015) earnings	84,240	68,654	63,229	51,905
Real (2015) earnings partner	37,770	38,669	71,803	66,812
Real (2015) household earnings	115,956	99,751	123,661	107,654
Children academic enrollment	56.1%	50.0%	58.8%	54.6%
II. Dentistry				
Partner at age 35	82.5%	77.9%	80.8%	82.2%
Partner college degree	62.6%	65.0%	65.8%	62.4%
Partner same educational field	30.2%	21.9%	24.0%	20.0%
Partner dentistry degree	17.0%	10.9%	17.2%	9.5%
Number of children at age 35	1.24	1.09	1.51	1.42
Real (2015) earnings	118,070	86,437	83,040	61,085
Real (2015) earnings partner	41,326	42,440	78,127	73,710
Real (2015) household earnings	153,053	120,863	149,660	124,717
III. Veterinary medicine				
Partner at age 35	79.8%	73.9%	71.7%	74.8%
Partner college degree	59.4%	54.4%	49.3%	46.6%
Partner same educational field	25.5%	14.1%	15.5%	10.7%
Partner veterinary medicine degree	23.2%	8.1%	12.6%	3.8%
Number of children at age 35	1.15	1.02	1.16	1.16
Real (2015) earnings	66,620	59,332	36,518	38,893
Real (2015) earnings partner	31,045	32,850	60,133	56,857
Real (2015) household earnings	93,227	85,782	83,525	84,886
IV. International business				
Partner at age 35	75.3%	76.9%	78.6%	78.5%
Partner college degree	52.7%	51.8%	55.2%	51.9%
Partner same educational field	12.8%	10.6%	20.5%	14.5%
Partner international business degree	4.6%	1.7%	10.7%	3.5%
Number of children at age 35	0.95	0.97	1.17	1.18
Real (2015) earnings	78,002	72,462	54,512	48,985
Real (2015) earnings partner	36,084	35,085	77,501	76,543
Real (2015) household earnings	107,363	101,262	120,132	112,016
Children academic enrollment	50.5%	49.1%	59.4%	53.3%

Note: The observed differences between lottery losers and winners cannot be given a causal interpretation because there are compositional differences between the groups and because the lottery is weighted.

6 Results

This section first shows that the result of the first lottery is decisive for the study choice of 37% to 55% of the applicants. It then shows that field of study affects partner choice. Male doctors are more likely to have a partner (with a college degree) than male applicants who were not admitted to medicine. Winning applicants from all fields are more likely to have a partner from the same field of study than losing applicants, and female doctors and female veterinarians have partners who on average earn more than the partners of applicants that lost the lottery for these fields. Finally, this section shows that field of study influences the number of children and the likelihood that children do well in school.

First-stage results

The first-stage regressions show the effects of winning the first lottery on the probability of completing the respective lottery study program. As displayed in the first lines of each panel in Table 5, the first-stage estimates are all highly significant and the F-statistic is always sufficiently large. Winning the first lottery increases the probability to complete medicine by 41 percentage points for men and by 37 percentage points for women, while the probability to complete dentistry rises by 43 percentage points for men and by 44 percentage points for women. Winning the first lottery raises the likelihood to complete veterinary medicine by 50 percentage points for men and by 55 percentage points for women, whereas male and female winners of the first lottery are 47 and 53 percentage points, respectively, more likely to complete international business.

The second lines in each panel in Table 5 show that redefining the treatment variable as enrollment instead of completion increases the first-stage estimates somewhat, from 0.44 for women participating in the lottery for medicine to 0.74 for men participating in the lottery for international business studies. This means that IV estimates of effects of enrollment are 16% to 37% smaller than IV estimates of effects of completion. To keep results comparable with the descriptives from Section 2 and because completion is a clearer treatment than enrollment, we will present IV results in terms of the effects of completion.

Effects on partnership formation and partner choice

The first rows in each panel of Table 6 report IV estimates of the effect of completion of a lottery study on the probability of having a partner. Men who completed medicine are 7 percentage points more likely to have a partner at age 35 than men who lost the lottery for medicine and ended up in their next-best study. No such effect is found for female doctors or for applicants of the other lottery studies, although for men who studied veterinary medicine the point estimate is very similar to that for male doctors.[18]

[18] Table A5 in the Appendix reports the effects on the probability to be married or in a registered partnership at age 35. We find significant positive (negative) effects for male doctors (female veterinaries), but none for the remaining graduates. There are only small negative effects on the probability to be divorced by age 35 for graduates of international business.

Table 5: First-stage estimates

	Men			Women		
	$\hat{\lambda}$	s.e.	F	$\hat{\lambda}$	s.e.	F
I. Medicine						
Completion	0.41***	(0.01)	1956.0	0.37***	(0.01)	2354.3
Enrollment	0.50***	(0.01)	4179.2	0.44***	(0.01)	4284.5
II. Dentistry						
Completion	0.43***	(0.03)	182.2	0.44***	(0.03)	206.0
Enrollment	0.53***	(0.03)	391.7	0.51***	(0.03)	346.0
III. Veterinary medicine						
Completion	0.50***	(0.03)	301.1	0.55***	(0.02)	862.0
Enrollment	0.67***	(0.02)	926.9	0.62***	(0.02)	1630.4
IV. International Business						
Completion	0.47***	(0.01)	1629.6	0.53***	(0.02)	928.5
Enrollment	0.74***	(0.01)	5316.3	0.71***	(0.02)	2003.1

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery and interaction terms of the year of first lottery and lottery category.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

The next rows report the effects of completing lottery studies on the probabilities to have a partner with a certain level or type of education. We analyze whether an applicant's partner has 1) a college degree, 2) a degree from the same broad field of education as the applicant[19] and 3) a degree from the same lottery study program as the applicant.

First, positive effects of degree completion on the probability to have a partner with a college degree are only reported for male doctors. Conditioning on the applicants having a partner shows that this effect is driven by doctors' higher probability to have a partner. Since the vast majority of the lottery losers to all programs enrolls in college, there is little difference in terms of winners' and losers' level of education which might explain the absence of significant effects here.

Second, we find a strong positive impact on the likelihood to have a partner who completed a study in the same ISCED-classified field as the applicant, which for the lottery losers means having a partner educated in their second-best field ("Partner same field (uncorrected)"). When we account for the applicant's gender being in the minority or majority in the field and for the different sizes of fields (following the transformation proposed by Liu and Lu (2006)), the magnitude (and sometimes significance) of the estimates changes ("Partner same field (corrected)"). From the perspective of the prospective student who chooses a field of study, the uncorrected measure is probably the more relevant one as this is informative about the probability to have a partner who graduated from the same field of study. The uncorrected measure does not distinguish whether this is due to the sex ratio in the field, the size of the field or the strength of (corrected) assortative matching in the field.

[19]For the last outcome we again use the ISCED-classification and sort fields of study into the same twelve mutually exclusive categories as in our descriptive analysis in section 2.

Table 6: Instrumental variables estimates of the effects of degree completion on partnership formation and partner choice

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine				
Partner	0.07***	(0.02)	−0.00	(0.02)
Partner college degree	0.09***	(0.03)	0.04	(0.02)
Partner same field (uncorrected)	0.19***	(0.03)	0.10***	(0.02)
Partner same field (corrected)	0.14***	(0.04)	0.43***	(0.06)
Partner medical degree	0.21***	(0.02)	0.19***	(0.02)
II. Dentistry				
Partner	0.04	(0.06)	−0.05	(0.06)
Partner college degree	−0.11	(0.08)	0.01	(0.08)
Partner same field (uncorrected)	0.20**	(0.08)	0.04	(0.08)
Partner same field (corrected)	0.16	(0.13)	0.26	(0.22)
Partner dentistry degree	0.15***	(0.06)	0.17***	(0.06)
III. Veterinary medicine				
Partner	0.08	(0.05)	−0.04	(0.04)
Partner college degree	0.04	(0.07)	0.01	(0.05)
Partner same field (uncorrected)	0.25***	(0.07)	0.10**	(0.04)
Partner same field (corrected)	0.46***	(0.13)	0.10	(0.06)
Partner veterinary medicine degree	0.31***	(0.05)	0.18***	(0.03)
IV. International Business				
Partner	−0.02	(0.02)	0.03	(0.03)
Partner college degree	−0.02	(0.03)	0.06	(0.04)
Partner same field (uncorrected)	0.05**	(0.03)	0.11***	(0.04)
Partner same field (corrected)	−0.14***	(0.05)	−0.02	(0.05)
Partner international business degree	0.07***	(0.01)	0.15***	(0.02)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, and dummy variables for the year when the outcome is observed. "Partner same field" is a dummy variable rescaled using the transformation proposed by Liu and Lu (2006).
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

Third, both male and female lottery winners are more likely to be in a partnership with somebody who obtained a degree in the same lottery study program compared with non-admitted applicants. The effects tend to be larger than those we found for having a partner from the same field as lottery winners are more likely to meet (more) graduates from the lottery study program than the losers. The estimates are largest for veterinarians and doctors and somewhat smaller, but still substantial for dentists.[20] The effects are again smallest for international business, the program that is most similar to lottery losers' commonly chosen alternative study programs. Again, we tend to find larger effects for the sex that is in the minority in the respective study program, while relatively similar effects for the gender-balanced field of dentistry.

[20] The effects conditional on having a partner are again quantitatively similar for doctors.

The results indicate strong effects on assortative matching based on field of education and study program. The results are in line with Eika et al. (2014) who find substantial rates of assortative matching by college major in Norway. The graduates of our four lottery programs search to a larger extent for a partner within the social network of their study program or their profession than the lottery losers, which might be due to their preferences, meeting opportunities or labor market prospects. College and the workplace play a more important role as a marriage market for them than for the lottery losers in their second-best fields. The estimated effects might thereby be largest for medicine and veterinary medicine as the labor markets for these graduates likely bring about social and professional networks that are more homogeneous in terms of educational field than the networks of other college graduates.

Earnings returns

We now turn to estimates of the effect of completing a lottery study on the annual earnings of the applicants themselves, of their partners and their households. We focus on earnings at age 35, which is 15 to 17 years after their first lottery participation.[21]

For applicants' annual earnings, we estimate substantial returns to completing medicine for both male and female doctors (Table 7). The returns to a dentistry degree are even larger amounting to more than €66,000 for men and €40,000 for women. Completing international business or veterinary medicine does not significantly increase earnings for men. Female international business graduates earn almost €5,000 more than the lottery losers, while female veterinary medicine graduates earn almost €5,000 less than the lottery losers.

The earnings differences between partners of male doctors and non-doctors are negative, but not significantly so, while female doctors have partners who earn significantly more than the partners of female non-doctors. This is likely in part due to the high degree of assortative matching that we found above as many female doctors have a partner with a medical degree. Female dentists also more often have a partner who works as dentist, but the large earnings differences relative to partners of non-admitted applicants for dentistry are imprecisely estimated and not statistically different from zero. While the partners of male veterinarians earn insignificantly less than the partners of lottery losers, the partners of female veterinarians earn about 7,400 euros more per year than their counterparts. Completing international business does not lead to earnings returns in the form of higher partner income.

Finally, we estimate the effects of degree completion on household earnings when the applicants are aged 35. The household earnings returns are qualitatively similar to the individual returns. Both male and female doctors' households reap substantial returns to completing medicine, but the returns are now considerably larger for women which may again be driven by their higher propensity to be in a partnership with another doctor. The returns for dentists are higher than those for doctors amounting to almost €70,000 per year for men and €43,000 for women. The negative returns for female veterinarians and the positive returns for their

[21] The effects on earnings of applicants for medicine and dentistry for up to 22 years after the first lottery are explored in detail in Ketel et al. (2016) and Ketel et al. (2018).

Table 7: Instrumental variables estimates of the effects of degree completion on annual individual, partner and household earnings

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine				
Earnings	32,940***	(2979)	29,781***	(1915)
Partner earnings	-2182	(1797)	12,764***	(3627)
Household earnings	34,504***	(3513)	40,926***	(3851)
II. Dentistry				
Earnings	66,196***	(11,241)	40,900***	(8260)
Partner earnings	1337	(6519)	7422	(10,668)
Household earnings	69,774***	(13,148)	42,791***	(13,419)
III. Veterinary medicine				
Earnings	7505	(6344)	-4613*	(2539)
Partner earnings	-3256	(4028)	7435*	(4134)
Household earnings	7366	(7881)	-1545	(4856)
IV. International Business				
Earnings	1,409	(3858)	4766*	(2847)
Partner earnings	-1358	(1937)	-1801	(5646)
Household earnings	-416	(4503)	7661	(6173)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, and dummy variables for the year when the outcome is observed.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

partners roughly offset each other, so that there are no significant differences in household earnings relative to lottery losers. There are no significant household earnings returns for male veterinarians and for international business graduates.

Effects on fertility

Table 8 reports estimates of the effects of degree completion on the total number of children at age 35. Male doctors have on average more children at that age than male non-doctors. For female doctors we do not find significant differences in the average number of children. The gender differences for doctors may reflect the greater difficulty of women to combine family and work in comparison to their male colleagues. For graduates from the other three programs, there are no significant differences in fertility in comparison to non-admitted applicants. For male dentists and male veterinarians the point estimates are, however, quite similar to those of male doctors.[22] While there may be a positive earnings effect for male doctors on their number of children, such an effect does not seem to exist for dentists even though their earnings returns are markedly higher. Graduates' preferences for children and family life seem to play a more important role in their fertility decisions than their earnings.

[22] Table A6 in the Appendix shows the effects on the probability to have at least one child by age 35. There are positive effects for male doctors, but now also for female doctors and male veterinaries.

Table 8: Instrumental variables estimates of the effects of degree completion on the number of children

	Men		**Women**	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine	0.36***	(0.06)	0.07	(0.05)
II. Dentistry	0.27	(0.17)	0.15	(0.18)
III. Veterinary medicine	0.21	(0.16)	0.04	(0.10)
IV. International Business	−0.05	(0.07)	−0.00	(0.09)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, and dummy variables for the year when the outcome is observed.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

Intergenerational effects

Finally, we report the estimates of the effect of completing medicine or international business on the probability that the applicants' children enroll in the highest track of secondary education. The sample sizes of dentistry and veterinary medicine applicants' children are too small to permit such an analysis. In the Netherlands, primary school education comprises eight years and begins when children are four years old. After that, they are tracked into one of three secondary education tracks: VMBO (pre-vocational secondary education), HAVO (senior general secondary education) and VWO (academic education). Selection is based on teacher recommendations and on national standardized exams that students take in the final year of primary school, i.e. at age 11/12. On average, about 20% of all students are admitted to the academic track.

To assess the selectivity into the estimation samples of children that we use below, we first estimate the effect of degree completion on the probability of having at least one child who is at an age where students typically enter secondary school, both conditional and unconditional on having children (Table A7 in the appendix). There are no significant differences between female medicine lottery winners and losers, while male doctors are more likely to have a child who is at an age of having entered secondary education. In line with the insignificant effects on fertility outcomes of international business graduates, there is no indication of selectivity into the sample of children for this program.

Children of male doctors are 7.4 percentage points more likely to enroll in the academic track than children of non-admitted applicants (Table 9). There are no differences in enrollment rates for children of female medicine lottery applicants. The effects on children of applicants for international business studies are insignificant when the father was the applicant and significantly positive when the mother was the applicant. The effect size of 8.9 percentage points is large relative to the baseline enrollment rates in the academic track of around 40%.

Table 9: Instrumental variables estimates of the effects of degree completion on children's academic enrollment

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine	0.074*	(0.039)	0.004	(0.033)
II. International business	−0.028	(0.031)	0.089**	(0.039)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, child's gender, child's age of enrollment in secondary education, and dummy variables for year of secondary school enrollment.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

7 Returns to medicine by second-best field of study

The counterfactual to completing medicine is the second-best field which the lottery losers chose. As Table 3 shows, the second-best fields are diverse, which makes it likely that the effects of completing medicine vary by second-best field. In this section, we take a closer look at the effects of completing medicine in comparison to several second-best fields of study. This provides additional insights into how these alternative fields are related to the family outcomes we consider.

The pairwise comparison of studies would be straightforward if the second-best field of study of each applicant was known. Since this is not the case for applicants who won the lottery and enroll in medicine, we use a procedure along the lines of Imbens and Rubin (1997).

We first divide all applicants into cells k based on their lottery category, lottery year and gender. Separately for each of the resulting 95 cells[23], we run IV-regressions of the outcome variables on the exogenous regressors (age at first application, non-western origin) and on the completion dummy using the result of the first lottery as instrument. For each cell, we store both the coefficient of the completion indicator ($\hat{\delta}_k$) and the variance of this estimate ($\hat{\sigma}^2_k$). Subsequently, we group the lottery losers' college degrees into four broad fields: 1) Health and Social Services (henceforth Health), 2) Social sciences (excl. Economics), Education, Humanities, Arts (henceforth Social Sciences), 3) Business, Law and Economics (BALawEcon), and 4) Science, Mathematics, Computing, Engineering, Manufacturing, Construction, Agriculture and Veterinary (STEM).

We slightly adapt the procedure that was developed by Imbens and Rubin (1997) to estimate outcome distributions of compliers in IV models and use it to estimate the fraction of compliers studying each of the four second-best fields we defined. We cannot identify compliers directly from the data, but can identify winning never takers (i.e. $LR_{i1} = 1$ and $C_i = 0$), and losing never takers and compliers combined (i.e. $LR_{i1} = 0$ and $C_i = 0$). For both groups we observe their distribution of second-best study choices. We also know the population shares ϕ_a, ϕ_n and ϕ_c of always takers, never takers and compliers, respectively. With that information, we can estimate the distribution of second-best study choices SC of the losing compliers in our data

[23] We consider 4 lottery categories (C-F), 12 lottery years (1988-1999) and men and women separately, so that we obtain 96 cells (4x12x2). Since one cell does not contain any lottery losers, we exclude it and end up with 95 cells.

set, i.e. the fraction of compliers in the four second-best fields:

$$\begin{aligned} P_c(SC|LR_{i1} = 0, C_i = 0) \; &= \; \frac{\phi_c + \phi_n}{\phi_c} \, f(SC|LR_{i1} = 0, C_i = 0) \, - \\ & \frac{\phi_n}{\phi_c} \;\, f(SC|LR_{i1} = 1, C_i = 0) \end{aligned} \tag{3}$$

Due to the randomization caused by the lottery, the distribution of losing compliers' second-best study choices is identical to the distribution of fields that winning compliers would have chosen. Keeping only one observation per cell k, we lastly regress the IV-coefficients obtained above ($\hat{\delta}_k$) on the four variables indicating the fractions of compliers in the four second-best fields (ρ_c^{Health}, $\rho_c^{Social\ Sciences}$, $\rho_c^{BALawEcon}$, ρ_c^{STEM}) obtained in equation (3), on lottery category (Lcat), lottery year (Lyear) and a gender dummy.[24] Thereby, we use the precision (i.e. the inverse of the variance $\hat{\sigma}_k^2$) of the IV-regression estimates as weights:

$$\begin{aligned} \hat{\delta}_k = \; & \beta_{Health} \; \rho_c^{Health} + \beta_{Social\ Sciences} \; \rho_c^{Social\ Sciences} + \beta_{BALawEcon} \; \rho_c^{BALawEcon} \\ & + \beta_{STEM} \; \rho_c^{STEM} + Lcat_k + Lyear_k + \delta female + U_k \end{aligned} \tag{4}$$

Table 10 reports results from this procedure for the probability to have a partner at age 35 and for partner characteristics. Differences in the estimates within a column should not be understood as differences in causal effects between for example medicine vs. Social Sciences and medicine vs. STEM. The reason is that applicants with different second-best fields are likely to have different potential outcomes, as doctor but also in each of the alternative fields. Each of the estimates can be interpreted as the effect for a specific complier group (e.g. the compliers who would have studied STEM if losing the first lottery for medicine).

The bottom row shows the IV-estimate for the average effect of medicine completion estimated using equation (1) for men and women combined (including a gender-dummy). Although the coefficient estimates vary considerably by second-best field, hardly any of the effects are statistically significant. First, the coefficients suggest that doctors whose second-best field is Health or STEM are less likely to have a partner than losing compliers, whereas doctors whose second-best field is Social Sciences and BALawEcon are more likely to have a partner than losing compliers. Second, the direction of the effects to have a partner with a college degree is always the same as for the likelihood to have a partner. Third, completing medicine increases the probability to have a partner from the same field relative to graduates in Social Sciences. Although the estimated effects are also large relative to Health and BALawEcon, whereby the latter effect is negative, they are not statistically different from zero. Lastly, doctors are considerably more likely to have a partner with a medical degree than graduates in other health-related study programs. The effects in comparison to the remaining three fields are insignificant although partly of non-negligible magnitude.

The differences in earnings and fertility at age 35 by second-best field are provided in Table 11. The earnings returns to medicine are highest for graduates whose alternative choice is an-

[24]Contrary to the previous analyses, we do not split the sample by gender as it would further reduce the power of the regression model.

Table 10: Differences in partner choice at age 35 of medicine graduates by second-best field of study

	Partner	Partner college degree	Partner same field	Partner medical degree
Health	−0.111	−0.224	0.288	0.377**
	(0.140)	(0.195)	(0.178)	(0.153)
Social Sciences	0.173	0.254	0.256*	0.198
	(0.110)	(0.156)	(0.149)	(0.129)
BALawEcon	0.169	0.092	−0.183	0.025
	(0.187)	(0.270)	(0.252)	(0.213)
STEM	−0.089	−0.133	0.102	0.155
	(0.123)	(0.170)	(0.161)	(0.141)
Total	0.030**	0.060***	0.137***	0.198***
	(0.014)	(0.017)	(0.017)	(0.013)

Notes: Standard errors in parentheses. Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

other health-related program or in the broad field of Social Sciences. The returns to completing medicine in comparison to BALawEcon and STEM are considerably lower and not statistically significant. Partner's earnings are lower in comparison to all fields except STEM, but these differences are always insignificant. Household earnings differences follow a similar pattern as individual earnings differences, albeit only the returns relative to Social Sciences differ significantly from zero at the 5% level. The estimated differences in the number of children at age 35 are all positive and of varying magnitude but are too imprecisely estimated to be of statistical significance. Nonetheless, the results suggest that the largest differences in fertility can be found between doctors and graduates in other health-related programs, Business, Law and Economics, while the differences are close to zero relative to STEM-graduates.

Table 11: Differences in earnings and fertility outcomes at age 35 of medicine graduates by second-best field of study

	Earnings	Partner earnings	Household earnings	Number of children
Health	51,123**	-20,771	29,445	0.427
	(21,387)	(16,420)	(31,088)	(0.421)
Social Sciences	43,544***	-11,592	47,278**	0.293
	(15,538)	(14,282)	(23,666)	(0.335)
BALawEcon	9195	-21,325	8160	0.485
	(26,879)	(21,709)	(40,986)	(0.575)
STEM	16,230	1618	7832	0.034
	(18,376)	(14,930)	(27,551)	(0.377)
Total	31,088***	6185***	37,998***	0.201***
	(1698)	(2190)	(2659)	(0.040)

Notes: Standard errors in parentheses. Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

8 Conclusion

This paper documents that family outcomes of college graduates differ substantially by their field of study. To deal with the self selection of students into fields of study, we exploit admission lotteries for four substantially oversubscribed study programs. Our results show that lottery winners are more likely to have a partner from the lottery field than lottery losers. We interpret this as evidence that search frictions play a role on the marriage market. However, the lottery winners are also more likely to find a partner in their field of study than the lottery losers. This indicates that search frictions are not the only explanation, but that also preferences are important for explaining assortative matching on the marriage market. Our analysis does not allow to quantify the importance of the different channels, which would require to also consider that losing a lottery may make someone less attractive for desired partners.

The channels through which fields of study influence labor market outcomes and fertility are probably even more complex. Own earnings are likely to influence and to be influenced by partner earnings, and both potentially influence and are influenced by fertility decisions. Children's educational outcomes my be directly influenced by own and partner's field of study, but most likely also by labor market outcomes, parents' ages at birth and the presence of siblings.

While pinning down the exact channels is an open question for future research, studies like ours show that not only labor market outcomes, but also important other dimensions of a person's life are causally influenced by field of study. This confirms the expectations of the students in the study of Wiswall and Zafar (2016), that their study choices will affect not only their career but also their family outcomes.

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A Appendix

A.1 Marital status

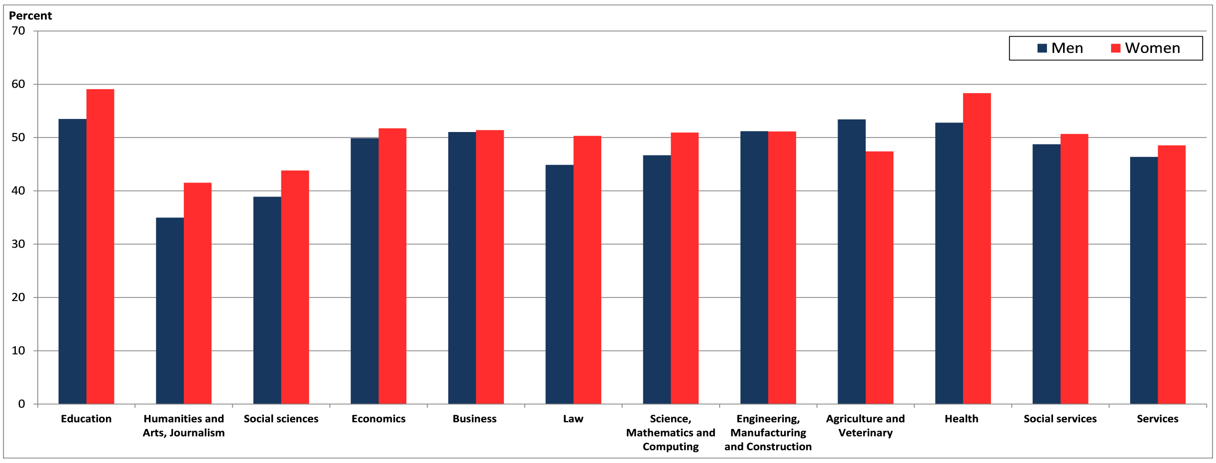

Figure A1: Probability to be married at age 35 by field of study

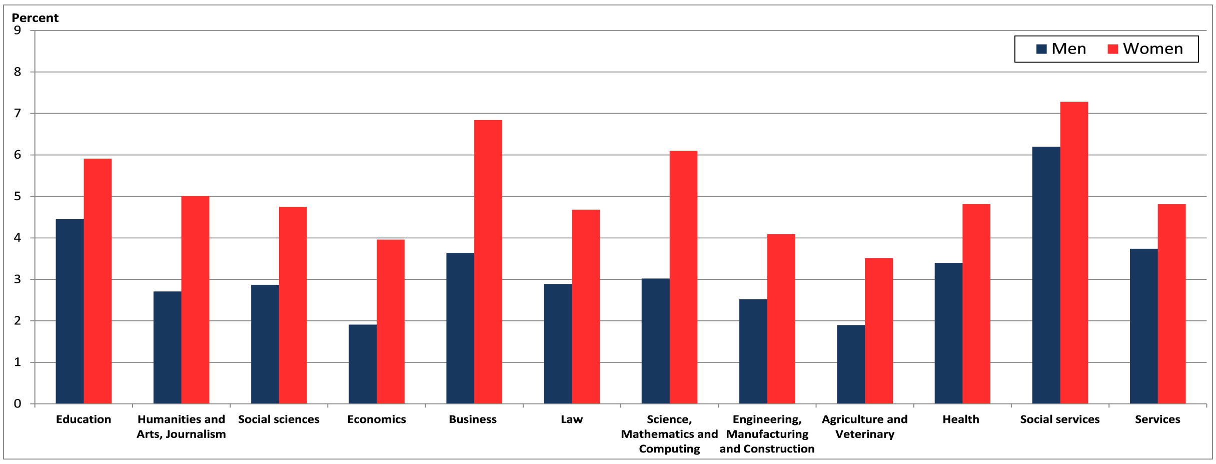

Figure A2: Probability to be divorced by age 35 by field of study

A.2 Descriptive analysis by birth cohort

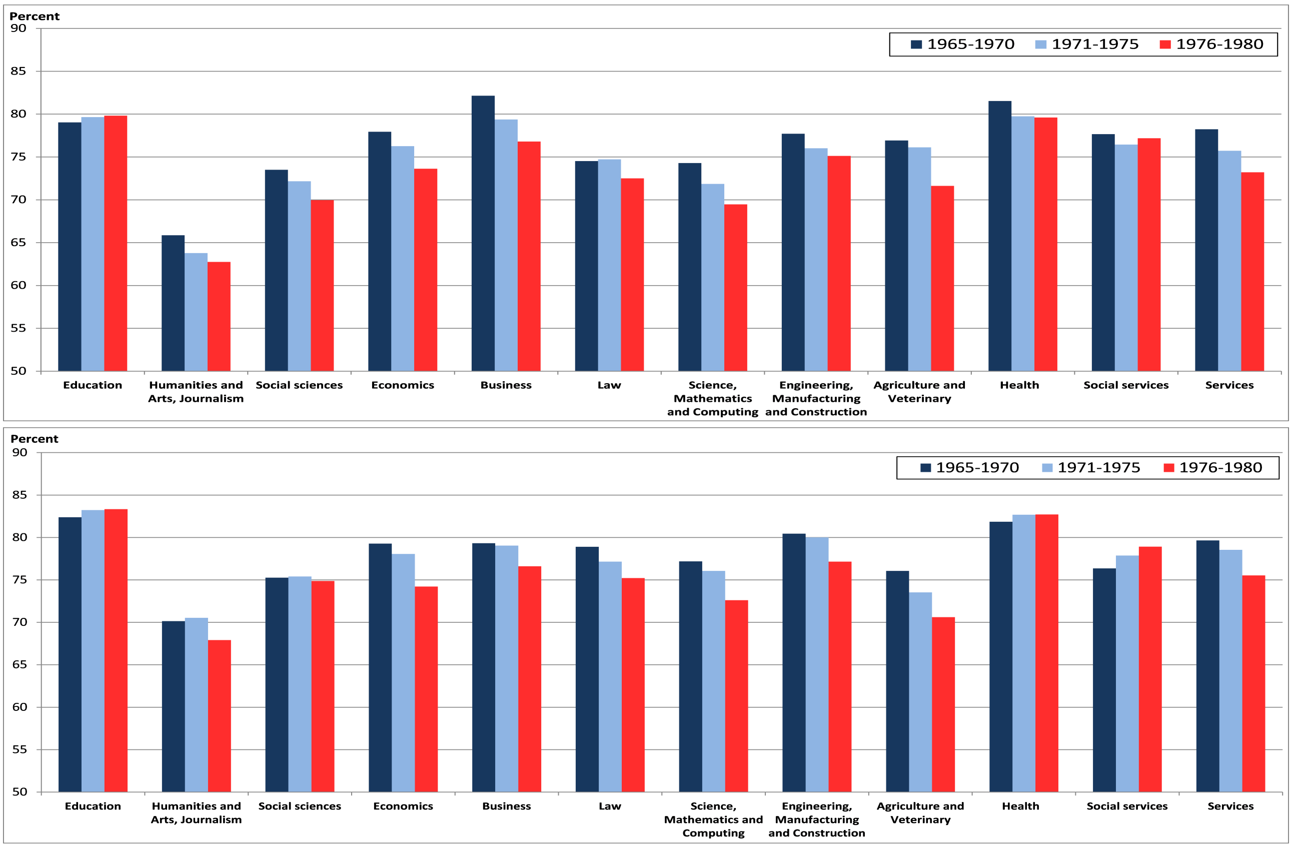

Figure A3: Probability of having a partner at age 35 by field of study for men (top panel) and women (bottom panel)

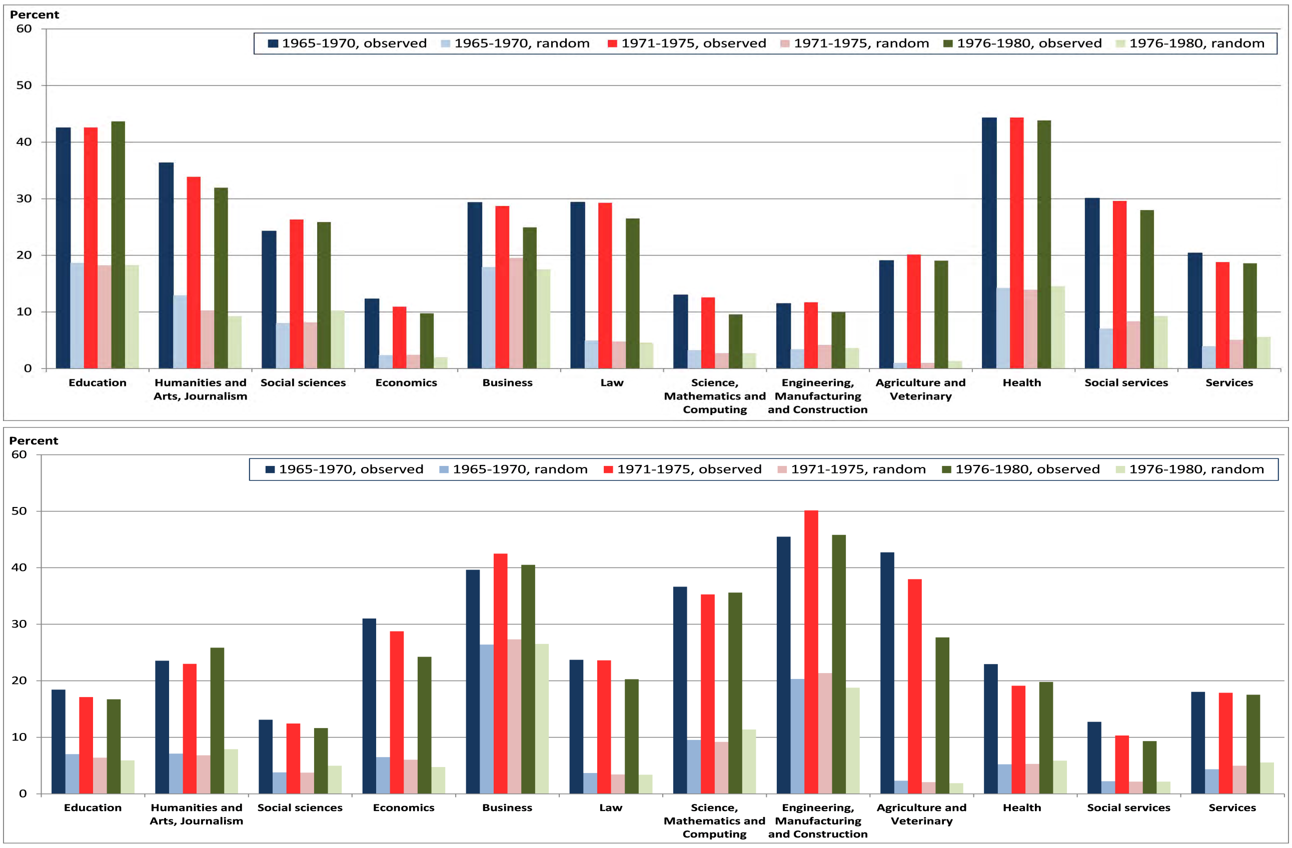

Figure A4: Share of male (top panel) and female (bottom panel) graduates with a partner from the same field

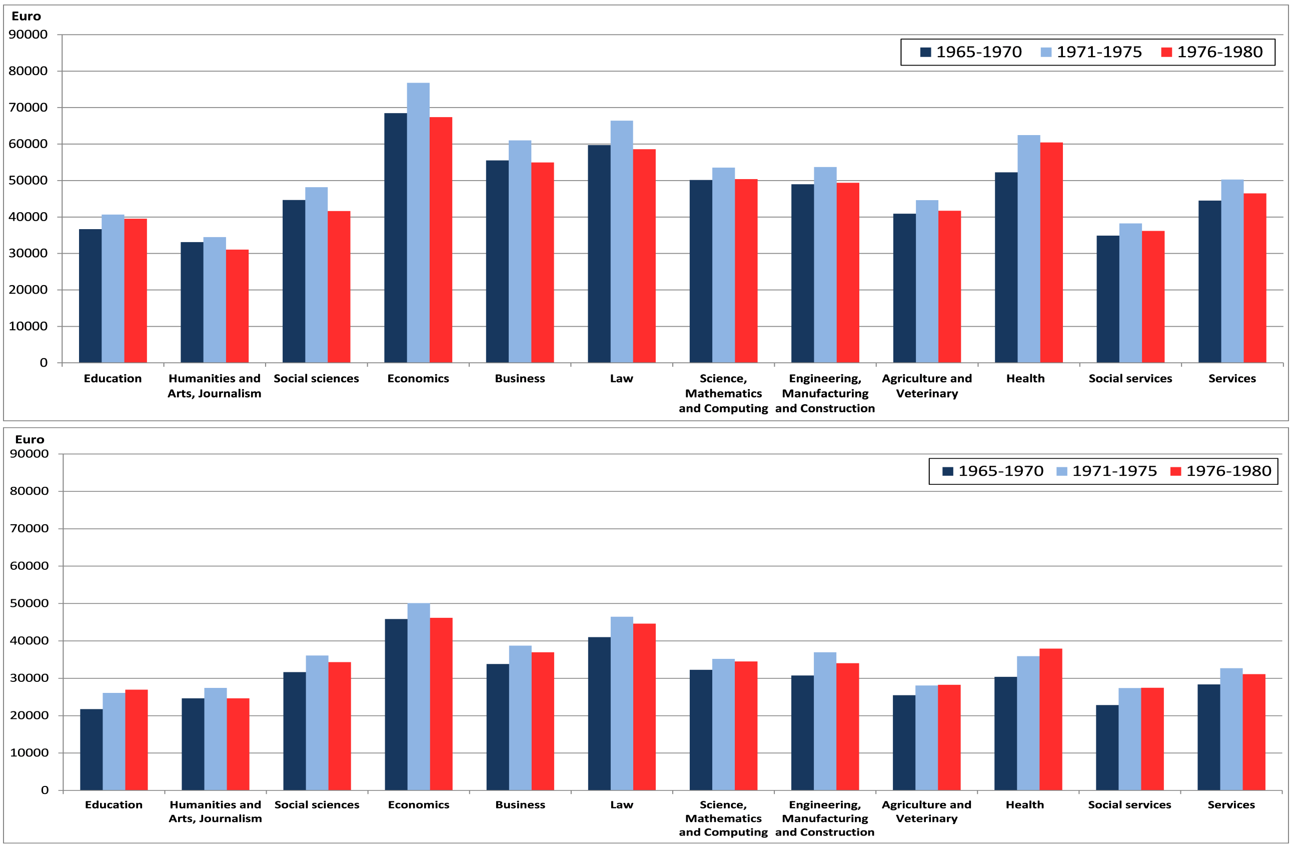

Figure A5: Average earnings at age 35 by field of study for men (top panel) and women (bottom panel)

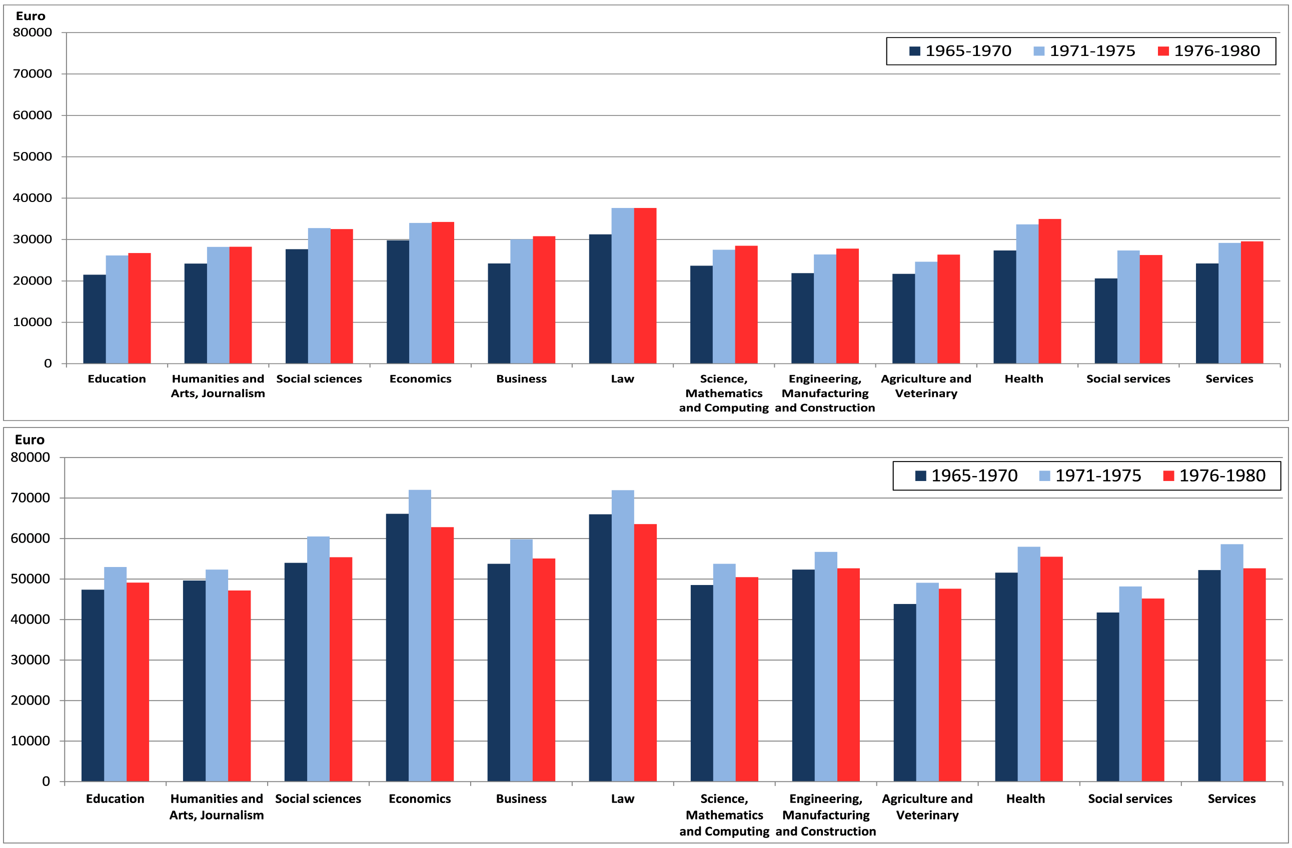

Figure A6: Average partner earnings at age 35 by field of study for men (top panel) and women (bottom panel)

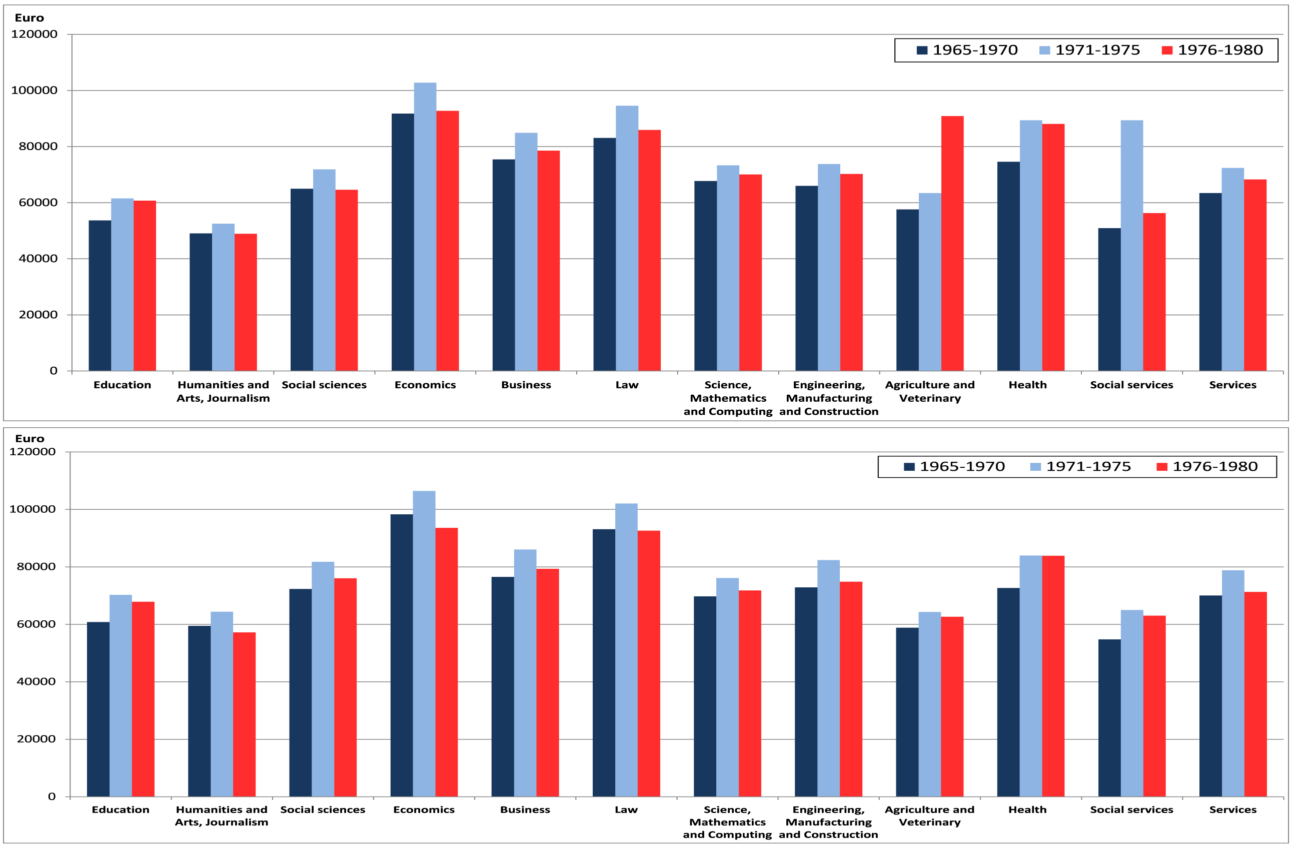

Figure A7: Average household earnings at age 35 by field of study for men (top panel) and women (bottom panel)

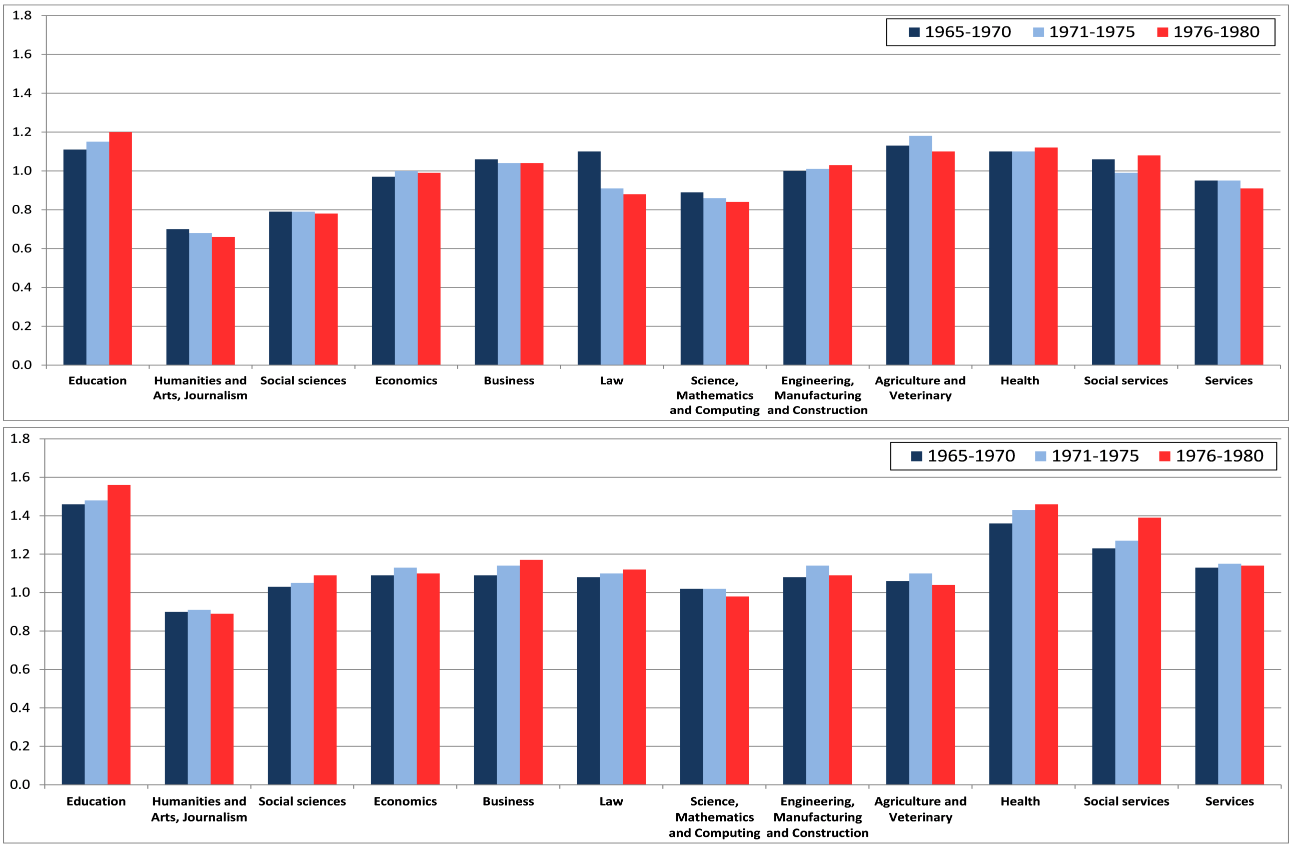

Figure A8: Average number of children at age 35 by field of study for men (top panel) and women (bottom panel)

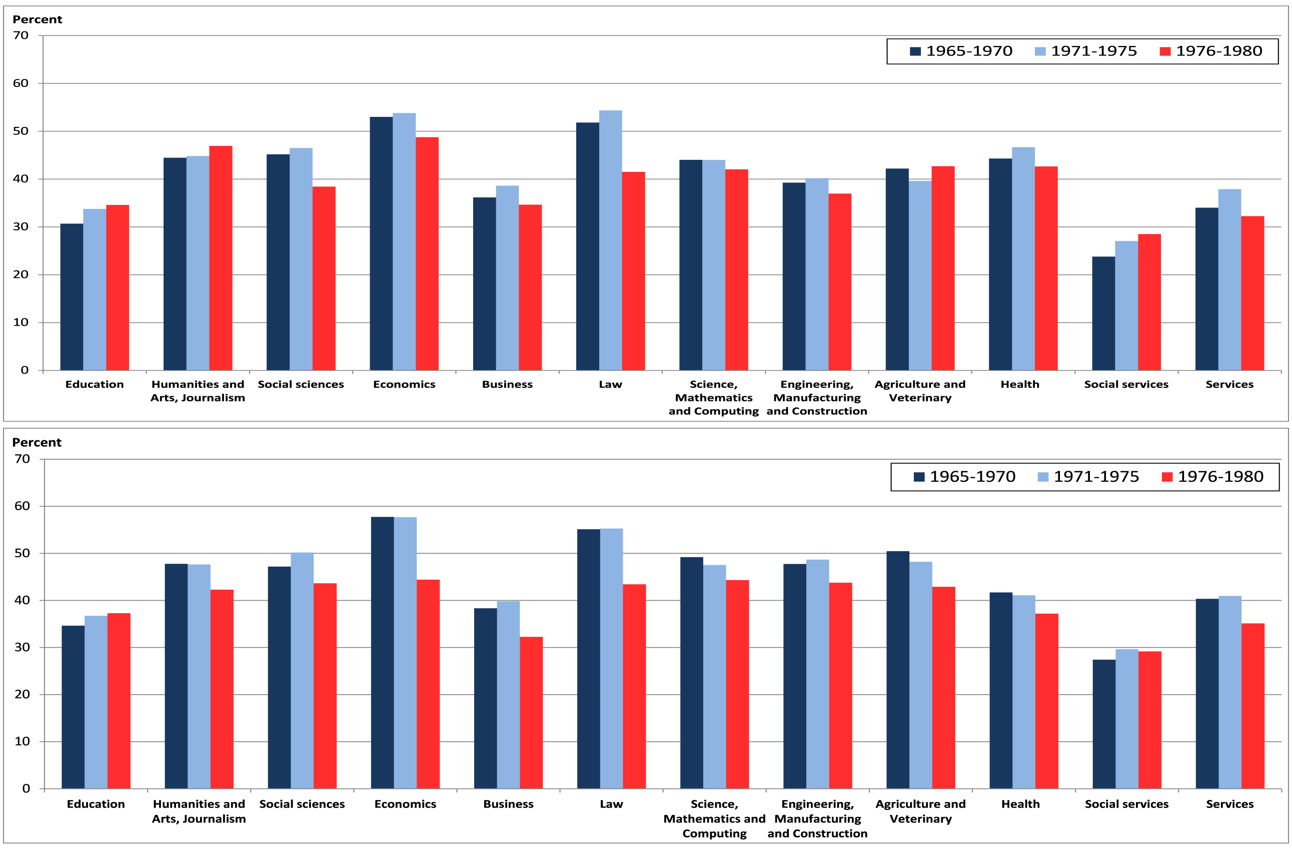

Figure A9: Fraction of secondary-school children that entered academic track VWO for men (top panel) and women (bottom panel)

A.3 Balancing tests

Table A1: Balancing of individual characteristics by outcome of the first medicine lottery application

	Lottery winners		Lottery losers	p-value
Lottery category B				
Female	58.9%		60.7%	0.75
Age at first application	18.0		17.9	0.65
Non-Western immigrant	4.8%		4.1%	0.60
N		1646		
Lottery category C				
Female	61.7%		62.4%	0.43
Age at first application	18.1		18.1	0.32
Non-Western immigrant	4.2%		4.0%	0.46
N		2582		
Lottery category D				
Female	58.6%		58.8%	0.75
Age at first application	18.2		18.2	0.54
Non-Western immigrant	5.5%		5.4%	0.62
N		5772		
Lottery category E				
Female	57.1%		58.5%	0.24
Age at first application	18.4		18.4	0.68
Non-Western immigrant	7.7%		7.5%	0.39
N		6159		
Lottery category F				
Female	55.7%		55.7%	0.82
Age at first application	18.6		18.6	0.01
Non-Western immigrant	10.5%		10.3%	0.36
N		8153		

Note: The p-values in the final column are weighted by the admittance probabilities for students in different years of lottery application.

Table A2: Balancing of individual characteristics by outcome of the first dentistry lottery application

	Lottery winners		Lottery losers	p-value
Lottery category B				
Female	71.8%		66.7%	0.38
Age at first application	18.1		17.8	0.42
Non-Western immigrant	5.3%		11.1%	0.45
N		48		
Lottery category C				
Female	49.3%		48.5%	0.99
Age at first application	18.2		17.9	0.17
Non-Western immigrant	7.6%		6.1%	0.48
N		100		
Lottery category D				
Female	55.6%		54.0%	0.64
Age at first application	18.3		18.3	0.22
Non-Western immigrant	8.2%		6.5%	0.38
N		310		
Lottery category E				
Female	50.0%		48.3%	0.58
Age at first application	18.5		18.6	0.04
Non-Western immigrant	8.4%		7.1%	0.34
N		495		
Lottery category F				
Female	43.9%		50.2%	0.11
Age at first application	18.8		18.7	0.14
Non-Western immigrant	9.2%		11.9%	0.17
N		858		

Note: The p-values in the final column are weighted by the admittance probabilities for students in different years of lottery application.

Table A3: Balancing of individual characteristics by outcome of the first veterinary medicine lottery application

	Lottery winners		Lottery losers	p-value
Lottery category B				
Female	71.2%		70.8%	0.89
Age at first application	18.0		17.9	0.33
Non-Western immigrant	0.0%		3.1%	0.00
N		124		
Lottery category C				
Female	66.1%		66.5%	0.65
Age at first application	18.1		18.0	0.08
Non-Western immigrant	2.7%		0.6%	0.07
N		294		
Lottery category D				
Female	62.1%		69.9%	0.05
Age at first application	18.2		18.3	0.09
Non-Western immigrant	1.3%		1.4%	0.97
N		802		
Lottery category E				
Female	69.2%		64.1%	0.14
Age at first application	18.5		18.4	0.57
Non-Western immigrant	3.8%		1.9%	0.07
N		1079		
Lottery category F				
Female	65.2%		65.5%	0.68
Age at first application	18.7		18.7	0.69
Non-Western immigrant	2.6%		1.8%	0.46
N		1468		

Note: The p-values in the final column are weighted by the admittance probabilities for students in different years of lottery application.

Table A4: Balancing of individual characteristics by outcome of the first international business lottery application

	Lottery winners	Lottery losers	p-value
Lottery category B			
Female	39.4%	37.8%	0.71
Age at first application	18.1	18.1	0.87
Non-Western immigrant	4.1%	0.0%	0.00
N	271		
Lottery category C			
Female	36.7%	37.1%	0.30
Age at first application	18.2	18.1	0.43
Non-Western immigrant	4.5%	3.2%	0.44
N	589		
Lottery category D			
Female	32.9%	34.0%	0.70
Age at first application	18.3	18.4	0.22
Non-Western immigrant	3.7%	2.6%	0.74
N	1765		
Lottery category E			
Female	31.5%	28.9%	0.20
Age at first application	18.6	18.6	0.60
Non-Western immigrant	5.6%	3.3%	0.02
N	2183		
Lottery category F			
Female	28.4%	29.3%	0.58
Age at first application	18.7	18.7	0.55
Non-Western immigrant	6.1%	5.3%	0.60
N	3172		

Note: The p-values in the final column are weighted by the admittance probabilities for students in different years of lottery application.

A.4 Marital status

Table A5: Instrumental variables estimates of the effects of degree completion on marital status

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine				
Married	0.13***	(0.03)	0.01	(0.02)
Divorced	−0.03	(0.02)	−0.04	(0.02)
II. Dentistry				
Married	0.13	(0.08)	−0.04	(0.08)
Divorced	0.02	(0.02)	0.00	(0.02)
III. Veterinary medicine				
Married	0.03	(0.07)	−0.08*	(0.04)
Divorced	−0.00	(0.02)	0.02	(0.01)
IV. International Business				
Married	0.02	(0.03)	−0.01	(0.04)
Divorced	−0.02*	(0.01)	−0.03**	(0.01)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, and dummy variables for the year when the outcome is observed.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

A.5 First child

Table A6: Instrumental variables estimates of the effects of degree completion on the probability to have a first child

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine	0.12***	(0.03)	0.04*	(0.02)
II. Dentistry	0.11	(0.08)	−0.01	(0.07)
III. Veterinary medicine	0.12*	(0.07)	0.00	(0.05)
IV. International Business	−0.01	(0.03)	0.01	(0.04)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, interaction terms of the year of first lottery and lottery category, and dummy variables for the year when the outcome is observed.
Levels of statistical significance: * p<0.10, ** p<0.05, *** p<0.01

A.6 Selection into intergenerational sample

Table A7: Instrumental variables estimates of the effects of degree completion on sample selectivity

	Men		Women	
	$\hat{\delta}$	s.e.	$\hat{\delta}$	s.e.
I. Medicine				
Unconditional on having children	0.084***	(0.019)	0.023	(0.018)
Conditional on having children	0.075**	(0.023)	0.003	(0.020)
II. International business				
Unconditional on having children	−0.032	(0.031)	0.025	(0.041)
Conditional on having children	−0.005	(0.032)	0.015	(0.039)

Notes: All specifications include controls for ethnicity, age at the first lottery application, lottery category, year of first lottery, and interaction terms of the year of first lottery and lottery category.
Levels of statistical significance: * $p<0.10$, ** $p<0.05$, *** $p<0.01$