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Nikoloz Kudashvili
Gega Todua

CERGE-EI
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Nikoloz Kudashvili and Gega Todua†

Abstract

Students may hold inaccurate beliefs about earnings and employment opportunities when making their education decisions. This paper analyzes the effects of information provision on student's intended and actual college major choices in Georgia. Secondary school students in our experiment systematically overestimated the earnings and unemployment rates of college graduates. We find that 10 percent more students who received information on actual earnings and unemployment changed their actual college major choices than others. The changes in their majors are partly driven by differences in the perceived and actual unemployment rates, whereas the earning differences do not appear to play a role. We also estimate spillover effects on students who do not receive information directly, and show that they matter, but only for older students who are closer to high school graduation. Importantly, we find that the immediate changes in the intended choices are not linked to the final major choices, suggesting that measuring the effects of information on immediately expressed intentions may not be sufficient to understand how information affects actual real-life decisions. We find that both direct and indirect information provision have sizable effects on student college major choices.

Keywords: college major, perceived unemployment, perceived earnings, information

JEL classification: C93; D84; I26; J24

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† Nikoloz Kudashvili: CERGE-EI, a joint workplace of Center for Economic Research and Graduate Education, Charles University and the Economics Institute of the Czech Academy of Sciences, Politickych veznu 7, P.O. Box 882, 111 21 Prague 1, Czech Republic; nikoloz.kudashvili@cerge-ei.cz.
Gega Todua: CERGE-EI, a joint workplace of Center for Economic Research and Graduate Education, Charles University and the Economics Institute of the Czech Academy of Sciences; gega.todua@cerge-ei.cz.

1. Introduction

College major choices represent an important specialization-specific human capital investment and can largely determine an individual's future earnings and career prospects (Hastings et al. 2013). However, little is known about how students choose college majors (Kirkeboen et al. 2016). A large number of studies have emphasized the roles of factors affecting students' choices including tastes, parental education, credit constraints, and pecuniary and non-pecuniary benefits. Pecuniary benefits are an important consideration and are largely determined by future salary and employment opportunities. However, many students likely make their major choices based primarily on their subjective beliefs (Arcidiacono et al. 2012 and Montmarquette et al. 2002) as the information on the salaries and unemployment rates for each major may not be perfectly observed by the students. Indeed, a growing body of studies has shown that students do not hold accurate beliefs about earnings conditional on a college major (Betts 1996, Conlon 2020, Jensen 2010, Nguyen 2008, Wiswall and Zafar 2015b). Furthermore, Hastings et al. (2016), Oreupoulos and Dunn (2014), and Wiswall and Zafar (2015a) find that students in Chile, Canada, and the US overestimate returns to post-secondary or higher education. In contrast, Conlon (2020) and Jensen (2010) find that students underestimate returns in the US and Dominican Republic, respectively. These studies illustrate that there is large heterogeneity in students' perceived earnings.

Due to a dearth of accurate information students may make suboptimal educational decisions based on perceived potential earnings and employment opportunities. Therefore, college major choices made under imperfect information may be inefficient for students and the society as

a whole.[1] In such settings, policy interventions providing relevant information could help students to make better-informed choices (Bettinger et a. 2012, Conlon 2020, Dinkelman and Martínez 2014, Hastings and Weinstein 2008, Jensen 2010, Nguyen 2008). Nevertheless, little is known about the mechanisms through which information affects students' educational choices.

Using a novel experimental design, we focus on direct and indirect effects of information provision on student college major choices. We extend the literature on educational choices in two ways. Firstly, we investigate the effects of indirect information provision, i.e., allowing for information spillover effects on specialization choices.[2] Secondly, we focus on the immediate (intended) and actual changes in student college major choices in response to the provision of information. A handful of studies consider the immediate effects of information, however, these changes in behavior may not concretely inform real-life choices. For this reason, we study the persistency in terms of both direct and indirect information effects in terms immediate and actual (final) outcomes. Additionally, we study whether responsiveness to information depends on age. Observing the intended and actual changes for the younger and older students, we discuss possible alternative timing of the information provision and the effectiveness of such interventions.

The experiment was conducted in three rounds in 2017-2019 on tenth and eleventh grade students in Tbilisi, Georgia. At the time of the experiment, tenth grade students had two years to make an actual college major decision, while eleventh grade students had only one year. In the first round, we elicited students' *baseline intended college major choices* and beliefs about the average earnings and unemployment rates of individuals for every field of study, and the same for

[1] Information provision could have a stronger impact on choices and efficiency in less developed countries with few or limited possibilities for students to access accurate and relevant information. Information on earnings and unemployment rates are not available in Georgia, rather Georgian Statistical Office publishes wages by industry.
[2] We use the terms specialization and college major choices interchangeably throughout the paper.

those workers with no tertiary education. Further, we implemented a belief elicitation mechanism by providing incentives to students to truthfully report their major choices.[3] Then, schools were randomly divided into control and treated groups. A randomly selected half of the classes in the treated schools received information on the population earnings and unemployment figures (direct provision - treatment group). The remaining half in the treated schools were not given any information (indirect provision - spillover group). However, their peers from the same school could pass the information on to them (indirect provision). In the second round, a month after the first round, we surveyed students and collected *revised intended college major choices*. In the third round, we collected their *actual college major choices.*[4] Hence, the two main outcome variables of the experiment are *the revised intended and actual college major choices*.

This study answers the following key questions: (i) Do students respond to the information provided? Do they hold accurate beliefs about earnings and unemployment? (ii) When is the ideal time to intervene, i.e., is the information more relevant to the older (younger) students? (iii) Does the information have to be provided directly or can it be effectively passed on by other students? This would be easier and less costly for policy makers to implement. (iv) How do the treatment and spillover effects differ in terms of the intended and actual college major choices? (v) What are the channels through which information affects college major choices?

We find that the students in our sample overestimate wages and unemployment rates for all study fields, and underestimate the salaries of individuals with no tertiary education. Using actual major choices data, we find that students with the information we provide are 10 percent

[3] We made an announcement that we were sending specific major information to students after the first round (see section 2.3).

[4] We followed up with the eleventh-grade students after a year, while tenth grade students were followed up after two years, when their actual college major choices were finalized.

more likely to change their actual college majors. Interestingly, the treatment effect is largely driven by the eleventh-grade students. Thus, too early intervention may be less effective. Furthermore, the spillover effect is significant but smaller than the impact of direct information.[5]

The structure of specialization revisions differs when we compare the intended and actual college major choices. 82 percent of the actual choice revisions are made by the students who did not revise their intended choices, i.e., their baseline and revised intended choices were identical. The treatment effect is 1 percent smaller in the actual choices sample compared to the intended choices. Unlike the treatment effect, the spillover effect is 3 percent higher in the actual choices sample. We argue that studies that consider only immediate effects of an intervention and ignore the final outcomes may not be accurately analyzing treatment effects on real-life decisions.

We find that the differences between the *actual and perceived unemployment rates* have a significant effect on actual major choices. At first glance, this result may be puzzling as these students changed their majors in favor of the specializations with high unemployment rate. Why would students revise their choices in this way? Students' perceived difference between the unemployment rates for the two choices they were considering was large, and so they opted for the major they thought offered significantly better chances for employment. [6] However, when they learned via the informational leaflet that the gap between the two majors was not as large as they imagined, the cost of changing to the major they actually preferred was smaller than they had believed. Initially, this group of students overestimated the potential unemployment cost of

[5] The spillover effect becomes insignificant in the full sample after controlling for covariates. However, the effect remains significant in the subsample of the eleventh-grade students.

[6] Consider a student with a baseline intended major choice of Medical sciences with an unemployment rate of 10%, who ultimately chooses the major 'Exact and Natural sciences', which has a higher unemployment rate of 12.6%. Hence, the actual cost of changing the major in the form of a higher unemployment rate is 2.6% (see Table 3, column 4). Prior to the intervention, students perceived that the cost of changing the major in this case was 5%, nearly twice as high in actuality (see Table 3, column 5).

changing their major. Thus, revision of the major toward the more desired specialization for these students, would not result in a drastic decrease in their employment opportunities. We refer to this as 'the relative unemployment rate channel' to explain the pattern in college major revisions. In addition to this channel, preferences and other unobserved factors must be behind the complex decision-making behavior regarding college majors (Wiswall and Zafar, 2015a).

However, we do not find evidence that students revise their choices toward higher wages or higher expected earnings.[7] The same is true for the differences between actual and perceived earnings. This can be explained by the relative importance of actual wages. For instance, a student may not find average earnings data relevant for her future earnings if she considers herself a high ability student. Alternatively, students may perceive that earnings distributions by major will change considerably by the time they graduate. Third, students may consider average wages less informative as the calculations still include the individuals with the Soviet education. Students may logically assume that a current tertiary education offers better career prospects. There may be still other reasons that the population earnings figures may not necessarily be relevant and informative.

Our study is related to research evaluating the effects of information provision on belief updating and actual educational choices where agents have inaccurate information or hold biased beliefs. In particular, Jensen (2010) finds that high school students in the Dominican Republic underestimate the earnings of individuals who completed secondary school. Provision of information on the true returns to secondary school education[8] had large and significant positive

[7] Expected earnings are calculated as the product of the wage and employment rate for any given college major. Note that the employment rate equals (1-unemployment rate).

[8] In these studies, actual (true population) salaries and unemployment rates are either given by the respective government statistics bureaus of a country, private organizations, or are calculated by the authors based on

effects on two outcomes – students revised their perceived returns upwards and completed about 0.2-0.35 more years of schooling. Similarly, Nguyen (2008) finds that the intervention improved students' school attendance and average test scores during the first few months following an experiment in Madagascar. Interestingly, Nguyen (2008) shows that a role model (a person from a poor/rich background presenting her/his success story) had a larger impact on student school attendance and performance than statistics provision. Wiswall and Zafar (2015a) show that students updated their beliefs on major-specific salaries after observing true earnings. Perceived earnings and abilities, along with heterogonous tastes, were the main drivers of specialization choices in a sample of New York University undergraduate students. Granguli et al. (2020) show that doctoral students were overly optimistic about their chances on the academic job market and updated their beliefs after information treatment. However, the study does not find any evidence of doctoral students changing their subsequent academic career plans (doing a postdoc or deciding on an academic job market placement).

Our results have implications for policymakers – both direct and indirect information provision have effects on intended and actual major choices. Both treatment and spillover effects are driven by older students implying that early interventions are less effective. The treatment effect is consistently stronger than the spillover effect in both actual and intended choice samples. Additionally, we find that the composition of the changes, treatment and spillover effects vary significantly in the actual and intended choices samples. Further research is needed to complement our findings on immediate and actual changes.

household surveys conducted prior to the experiment. The latter is usually used in cases of limited or no data availability (Jensen 2010, Nguyen 2008).

The remainder of the paper is organized as follows. Section 2 describes the data and field experiment. Section 3 presents the main results, section 4 concludes.

2. Field Experiment

2.1 Short Overview of the Georgian Education System

Georgia is a small country in the Caucasus region with a population of 3.7 million and a GDP per capita of $ 9,702 in 2017 (PPP adjusted).[9] The degree of urbanization is 58%. The capital of Georgia, Tbilisi, is the largest city, with a population of 1.1 million, and with over public 250 schools providing elementary, primary, and secondary education.

School education in Georgia consists of elementary (age 6-12), basic (age 12-15), and secondary (age 15-18) studies (Ministry of Education of Georgia). Students receive a Full General Certificate upon passing school leaving examinations at the end of the twelfth grade. Students with a school-leaving certificate have access to the higher education. University admissions have been centrally administered by the National Assessment and Examination Center (NAEC) of Georgia since 2005. All students wishing to enter accredited universities have to pass standardized written exams conducted by NAEC. Note that entrance examination subjects vary by major. For instance, entering a university with a major in Economics and Business would require a student to pass four examinations: Georgian language and literature, mathematics, general skills, and foreign languages.

The demand for each specialization at accredited universities in 2017 appears in Table A1. The demand for each major is defined as student's first desired specialization choice. All

[9] World Bank, https://data.worldbank.org/country/georgia [accessed 5 June 2019].

accredited Georgian universities were able and willing to admit nearly 50,000 students, while there were about 40,000 applicants in 2017. We aggregated the various university majors into six groups: (i) exact and natural sciences, (ii) medical sciences, (iii) economics and business, (iv) social sciences, (v) arts and humanities, and (vi) law. According to Table A1, the majority of applicants chose humanities, exact and natural sciences, and economics and business as their first college major choice in 2017.

2.2 Data

The experiment was conducted in three rounds in Tbilisi during 2017-2019. In the first round, 2015 students aged between 15 and 17 participated.[10] First round was administered at twenty-two randomly selected schools during regular school hours in April 2017. Students were asked to report their *baseline intended college major choices*, and their beliefs about what unemployment rates and earnings are for persons with a university diploma in that field. They were also asked to report on their individual and household characteristics in the baseline survey.[11] Each session lasted approximately 55 minutes.

The experiment was conducted on tenth and eleventh grade students. Twelfth grade students who intend to enter a university fill out their university applications in March every year. A student's university application is a combination of specialization and university choices submitted during the final year of secondary school. Although the formal decision about the major choice occurs in March, twelfth grade students make informal decisions at the beginning of their final year of studies. A student's informal major decision results in extensive private tutoring sessions in the subjects required for the unified entrance examinations. It is very common that

[10] Note that two students 18 years old.
[11] See Appendix B3.

students and their parents decide to pay additional fees for extensive tuition sessions for courses that are relevant to their college major choices. For instance, 78.3% of the students in our experiment reported that they either already had or intended to have a tutor to prepare for the unified examinations. Tutoring may increase their chances of being admitted at top universities and/or receiving merit-based state scholarships. As expected, the share of such students is higher in the eleventh grade (81.3%) than in the tenth grade (75.9%). This can be explained by the remaining time before the university enrollment - tenth grade students had about two years to go before making their major choices, hence they may have been less certain about their need to have a tutor. In contrast, eleventh grade students are about to start their preparation for the unified entrance examinations over the final year of their studies in a secondary school (twelfth grade). According to common practice, eleventh grade students and their parents usually search for tutors in the spring and summer for the upcoming September.[12]

A second survey of the students was conducted one month later (May 2017). Similar to first round, students were again asked to report their specialization choices; we refer to these second round choices as *revised intended college major choices*. The first and second round surveys were conducted using a pen and a paper. A third follow-up survey on major choices was conducted in September 2018 and 2019, by which time the students' final major choices were realized, i.e., students were admitted to universities.[13] Applicants usually learn about their test

[12] We did not consider students in their final year of studies (twelfth grade) in our experiment. Twelfth grade students are generally unlikely to change their majors for two reasons. Firstly, they have already attended tutor sessions in the subjects required for the major and hence, there are sunk costs in the form of tuition. Secondly, even if they wanted to change their majors, students would have little time to prepare for the new exam(s) for the different major.

[13] Students were also asked whether their desired major choices were different from the realized university major decisions that are dependent on test scores. Note that none of the students reported that they picked a different major choice due to the insufficient exam scores (Round 3). Thus, all the major choices were students' own decisions and were not driven by their exam scores.

scores and university admissions in late August, therefore September was the earliest possibility to track actual college major choices, the real-life outcomes in this case. In the third round, *actual major choices* were collected using telephone and email surveys, as students were no longer in the high schools where the experiment was originally administered.

The timeline of three experimental rounds appears in Table 1. Overall, we were able to obtain 95.9% follow-up responses in the May 2017 survey. In the third round, most of the responses were recorded via a phone communication - there were only four email responses that were not documented via phone call. This may be explained by low popularity of email communication, or students might have changed their school email addresses. In our experiment, 1,290 students provided their cell numbers, which is 67.4% of round-two observations.[14] We were able to track a large majority of student major choices. Indeed, the phone response rate was 89.7%. Overall, we were able to obtain follow-up information on 1,157 students in the September 2018 and 2019 phone survey – 27 students reported that they had not applied for the universities at all. Thus, we were able to track 1,130 students and record their major choices three times (baseline intended, revised intended and actual college major choices) for the period of 2017-2019. The overall attrition rate is 42%, hence, we further study whether the attrition is correlated with the treatment or spillover effect. Table A7 shows that neither treatment nor spillover effects are correlated with the attrition. However, we find that tenth-grade students are more likely to be missing in the final round (actual choices collection) than the eleventh-grade students. This effect is expected, as we followed up with eleventh- and tenth-grade students after one and two years respectively.

[14] Note that students optionally filled in their cell numbers in the questionnaire in the first round.

Tables 2.1, 2.2[15] and 2.3 show that there were no systematic differences in covariates across treatment, spillover, and control groups. Table 2.4 reports the school characteristics. These groups differ in terms of the information provision discussed below in detail.

2.3 The Intervention

In this section, we describe our experimental design to study the effects of direct and indirect information provision on college major choices. Our three experimental treatment groups differ with respect to the information provided to each group. Firstly, the schools were randomly divided into the control (C) and treated (T) schools. Students in the control schools (C) did not receive any information. Secondly, students in the treated schools were divided in treatment (TT) and spillover groups (TS).[16] Students in the TT group received information on earnings and unemployment rates by specialization; students in the spillover group did not receive any information. The control group included students from seven schools, and treatment and spillover groups included students from fifteen schools. Classes in each grade in every treated school were randomly divided into treatment and spillover groups. Thus, the randomization unit was at the class level in the treated schools. Note that, for this reason, student characteristics in three experimental groups may differ. Overall, 1,429 students were surveyed in the treated schools and 586 students in the control schools. There were 752 and 677 students in the TT and TS groups. First, students were asked to report their baseline college major choices. Next, we elicited student beliefs about the average earnings and unemployment rates of university graduates from each field

[15] We also run the randomization checks in the actual choices sample – we do not find any statistical differences across control, spillover and treatment groups (see table A8).

[16] TT- students received an information leaflet in the treated schools; TS – students did not receive an information leaflet in the treated schools. Thus, by our design, students in TT group could reveal information on earnings and unemployment rates to their peers in the spillover group (TS). Note that both TS and TT classes were located in the same school building.

and collected other relevant data (baseline survey). After the baseline survey, the intervention took place.

At the end of the first survey session, each student in the TT group was given the information on earnings and unemployment by specialization, calculated by the authors based on a household survey conducted by the statistical office of Georgia in 2015 (see Table 3). Overall, 98.52% of the students in the TT group found the information leaflet helpful for their choice of major decisions (see Appendix B2). In the second round, students were asked to state whether they discussed their major choices with their parents. More than 78% of students stated that they discussed their major choices with their parents in all three experimental groups.

To study whether information on earnings and employment affects their choices of major, we track the choices over three rounds – baseline intended, revised intended, and actual college major choices. We first measure the treatment effect by comparing the revision of major choices across the TT and C groups. Further, we examine the major choices revision rate across the TS and C groups, to identify any spillover effects. We incentivized students to truthfully report their baseline major choices. Students were told that they would receive an email with the major specific information. The major specific information included details about university application procedures and deadlines, admission requirements, top universities, and degree of competition (chances of being admitted) for each major. We emphasized that the information was major specific, i.e., students would benefit by indicating their 'truly desired' specialization and would receive relevant information by email. The sample information was shown to students but not distributed in the beginning of the experiment. 98.17% students provided their email addresses and over 99% students reported that they were interested in the major-specific information to be sent by email later. Thus, our incentivization scheme worked as intended. However, we are aware that

some students might still misreport their major choices, particularly those who were less certain about entering the university at all.

Table 3 reports average monthly salaries and unemployment rates for each college major choice, including individuals with no university education. Students in the treatment group were provided with the information (see Appendix B2). The earnings and unemployment figures were accompanied by an explanatory sheet explaining the differences in wages and employment likelihood for each major. Students were informed that they could ask questions straight away or send an email with a question if the leaflet was not clear. On the one hand, providing the unemployment rate could be interpreted as positive news for the students, because they overestimated unemployment for all major choices. On the other hand, providing actual earnings data could be perceived as negative news, because students overestimated wages for every major choice listed.

3. Experimental Results

First, we present the differences between student beliefs and actual data to scrutinize the motivation behind their college major choice revisions. Second, we investigate the effect of the information provided on major choices. In particular, we examine the patterns of college major choice revisions in treatment, spillover, and control groups. Third, we investigate channels rationalizing the revision of the major choices.

3.1 Perceived Earnings and Unemployment Rates

Do students hold accurate beliefs about earnings and unemployment rates? - We start the analysis by presenting the key differences between the perceived and actual figures. Table 3 shows actual and perceived mean monthly wages and unemployment rates for individuals with and

without tertiary education. First, individuals with a tertiary education earn about 59 percent more than workers with only a high school diploma. However, the difference is only 51 percent when comparing the expected wages that considers the higher unemployment rate among individuals with a tertiary education. Workers with a university degree in *law, and economics and business administration* earn the most. Second, students systematically overestimate[17] earnings for each major except for the earnings of individuals with no university education. Their overestimation is the highest for individuals with degrees in *medical sciences* and least for graduates in *exact and natural sciences*. Students perceive that workers with no tertiary education earn about 25% less than actual earnings. Unlike the findings in Jensen (2010) and Nguyen (2008), students in our sample, perceive that returns to tertiary education are large. Overestimation of tertiary education returns could partly explain high enrollment rates in the universities. Unsurprisingly, the percentage of the labor force with tertiary education in Georgia is high, at 31 percent, higher than most advanced European countries. This figure is even more pronounced in urban areas, where every second worker has a higher education diploma (World Bank report 72824, 2013). Students hold nearly accurate beliefs regarding expected earnings for the following specializations: *exact and natural sciences, and arts and humanities*.

Third, students overestimate the unemployment rate for all workers. Students perceive that the highest unemployment is among individuals with no tertiary education, followed by workers with a degree in *arts and humanities*. Interestingly, the perceived unemployment rate (46 percent) for individuals with no university education is 4.5 times higher than the actual unemployment rate (8 percent). In fact, the individuals with no tertiary education have the lowest unemployment rate

[17] Note that the beliefs were elicited before we provided the leaflet, to avoid contamination. High perceived returns in our sample can be ascribed to the experimental setting - the experiment was conducted in an urban area, where wages are generally higher than overall country wages.

(Table 3). One of the reasons for the overestimated unemployment rates may be connected to the peculiar employment structure in Georgia. Over 50 percent of workers are employed in the agricultural sector - contributing less than ten percent of the country's GDP. Rutkowski describes this strange phenomenon: "*while not contributing substantially to the economy overall, agriculture provides employment of last resort for those who cannot find jobs elsewhere, and eventually work as subsistence farmers*" (World Bank report 72824, 2013). Differences in employment trends are also observed in unemployment rates in the rural and urban areas – the latter being 28 percent, three times higher than in rural areas. This further reinforces the argument of the hidden unemployment in rural areas. Further, unlike the majority of European countries, highly educated individuals are more likely to remain unemployed over the long-term in Georgia. For instance, over 40 percent of unemployed individuals have higher education, and highly educated workers account for over 70 percent of the long-term unemployed (World Bank report 72824, 2013).[18]

The gap in the unemployment rate between workers with tertiary and secondary education is in sharp contrast with most EU countries. For instance, the EU28 unemployment rate for individuals with tertiary education in 2018 was only 3.9 percent, and 12.5 percent for individuals with no tertiary education.[19] However, workers with tertiary education in Georgia experience higher unemployment (13%) compared to workers with only secondary education (8%). Higher long-term unemployment among educated individuals and systematic underemployment for their skills are associated with losses in investments into human capital. Thus, providing the information

[18] Individuals are considered long-term unemployed if they have been unemployed longer than twelve months according to ILO.

[19] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190920-1?inheritRedirect=true&redirect=%2Feurostat%2Fhome%3F

about earnings and employment opportunities may help students to make more optimal educational choices.

3.2 Changes in the College Major Choices

First, we report the effects of information provision on intended major choices. We document the changes in the intended major choices across control, spillover, and treatment groups. Second, we present changes in the realized (actual) major choices. Our primary analysis is based on actual major choices, as they represent real-life outcomes, i.e., actual major choices collected after university admission decisions. Next, we explore the mechanism explaining the revision of major choices by looking at differences in perceived and actual earnings and unemployment rates for the baseline intended and actual major choices.

Do Students Revise Their Intended Major Choices Upon Observing Actual Earnings and Unemployment Rates? - Figure 1 shows that students in TT (treatment) and TS (spillover) groups revise their majors more frequently than do their peers in the control schools. Thus, information provision both directly and indirectly alters the main outcome variable to a greater extent in the TT and TS groups than in the control group. Students in the treatment and spillover groups revise their major choices by 11 percent and 4 percent more, respectively, and both effects are significant at 5 percent. Thus, the information has a significant effect on intended college major choices reported by students a month after the intervention. Table 4 (columns 3 and 4) shows that the treatment and spillover effects remain robust after controlling for covariates.[20]

Next, we analyze the revision patterns in the treatment and spillover groups across two grades, and notice significant differences. Interestingly, students in the tenth grade, including those

[20] The results remain significant in the probit model specification as well (Table 4, columns 5-6).

in the control group, revise their major choices more than eleventh grade students. This can be explained by less information availability or higher uncertainty about their future major choices. Why do revision rates differ by grade? Eleventh grade students had to decide about college majors within a year and therefore, they may logically have considered their major choices seriously beforehand and they were more certain about their major choices. This is indicated by relatively lower revision rates by the eleventh-grade students. By contrast, tenth grade students had nearly two years to choose a major, so their choices fluctuated more. Overall, the total revision rate across all three experimental groups in the tenth-grade students is 16 percent, compared to 13 percent in the eleventh grade. The revision rate differentials across the two grades is more salient for students in the control group. Indeed, Table 4 shows that 9 percent of tenth grade and 5 percent of eleventh grade students in the control group revised their majors. In fact, unstable choices undermined both the treatment and spillover effects in the sample of tenth grade students – the spillover effect is nearly zero; the treatment effect is significant but smaller than the one found in the sample of eleventh grade students. Thus, we conclude that changes in the intended major choices were more pronounced in the eleventh-grade students, and overall changes are also driven by older students.

Next, we present our analysis of *actual college major choices*. Both treatment and spillover effects are calculated by comparing changes between the actual and baseline intended college major choices. In line with our findings on the intended choices, we find that the treatment effect is positive and statistically significant at the 1 percent level. Figure 2 shows that students in the treatment group revise their major choices 10 percent more often than their peers in the control group. Table 5 derives similar results – the treatment effect is more pronounced in the sample of eleventh grade students. Overall, the spillover effect is 7 percent and significant at the 10 percent level, however, the effect is stronger at 11 percent and statistically more significant at the 1 percent

level among the eleventh-grade students. Furthermore, we find that 47 percent of the tenth-grade students revised their actual majors, compared to 23 percent of the eleventh-grade students. Hence, almost every second tenth grade student revised her/his choice. For this reason, there is a cleaner revision pattern across treatment, spillover and control groups for the eleven grade students. The treatment effect is 14 percent when controlling for covariates (Table 5). Thus, both the direct and indirect information have a significant and strong effect on actual specialization choices.

Our results shed the light on the intervention's timing. Both treatment and spillover effects are largely driven by the eleventh-grade students. That is, both direct and indirect provision of the information, a year before the university entry date, has a larger impact on actual choices.

Now we turn to the revision patterns in terms of the intended and actual changes in the college major choices. Are changes in the actual and intended college major choices consistent with each other; if a student revised her intended choice, did she also revise the actual choice? We find that the structure of revisions differs largely across intended and actual major choice samples. Most students who revised their actual choices compared to baseline, had not changed their intended choices.[21] 82 percent of the changes in the actual major choices were made by students whose baseline intended and revised intended choices were identical.[22] Thus, intended choices are

[21] Had not changed their intended choices in round 2 but did make a change in round 3.

[22] Note that we recorded 1,913 intended choices (round 2) and 1130 actual major choices (round 3). Could attrition drive the differences? Table A5 shows that there are no significant differences across treatment, spillover, and control groups for the students who did not report their actual choices (participated in the round 2, but did not participate in round 3). Moreover, the means in Table A5 are similar to those in Table 2.2. Next, we run an analysis of the intended choices sample on the round three sample and find that the treatment effect is significant but smaller than in the original round 2 sample (Table A6). Similarly, the spillover effect is insignificant in the whole sample but positive and significant in the subsample of eleventh-grade students. Thus, we do not find any evidence that attrition drives the differences between the analyses across the revised intended choices and actual choices data. Table A7 shows that the attrition is not correlated with the spillover or treatment effects. However, the attrition rate is 10% higher for tenth-grade students, which is intuitive – we tracked actual choices of the tenth-grade students after two years, as opposed to one year for the eleventh-grade students.

less suggestive in predicting the effect of information on real life outcomes. We report the results based on real life outcomes (actual major choices) below.

Result 1

Students revise their major choices upon observing actual earnings and unemployment figures. Students with information are 10 percent more likely to revise their actual majors. The effect is significant and robust to all model specifications in the full sample. The treatment effect is more pronounced in the sub-sample of eleventh grade students.

Result 2

The spillover effect is positive and significant in all model specifications in the subsample of eleventh-grade students, but the effect is insignificant in the whole sample after controlling for covariates. Thus, indirect information provision has a real impact on the choices of the older students.

3.3 Determinants of College Major Choice Revisions

Next, we explore the channels that explain the changes in college major choices. Students in the treatment group were given the leaflet displaying the monthly earnings and unemployment figures for each major (Appendix B2). Existing literature emphasizes the role of expected earnings and employment opportunities when deciding between specializations (Wiswall and Zafar, 2015a). A specialization with higher wages and lower unemployment could make this major more attractive. Provision of the information is a mixture of good and bad news. intuitively, the earnings statistics can be treated as negative news, as students perceived that wages were higher than the

actual ones, however, the unemployment statistics should be treated as positive news, as students largely underestimated graduates' employment chances.

Our analysis suggests that changes in the student specialization choices are explained by the differences between the actual and perceived unemployment rates. We refer to this as the '*relative unemployment rate*' channel.

How does this channel rationalize the changes in the college major choices? Consider students who revised their majors from medical sciences (baseline intended choice) to the exact and natural sciences (actual choice). Table 3 reports the actual and perceived unemployment rates of individuals with a degree in medical sciences, 10% and 25%, respectively. The same figures for the exact and natural sciences diploma holders are 12.6% and 30%. This implies that the *actual cost*[23] of changing one's major from medical sciences to exact and natural sciences is 2.6%. This is in stark contrast with the perceived costs of the same change – indeed, the *perceived cost* of this change is 5%. Thus, students in our sample overestimated their *cost* of changing the major in the form of lower employment opportunities. In fact, they only would give up 2.6% if they chose *exact and natural sciences* instead of *medical sciences.* However, they perceived that the revision would be associated with an increase in their unemployment by 5%, much larger than the actual difference, 2.6%.

Figure 7 displays the fraction of students who revised their actual major choices toward one with a lower relative unemployment rate, defined as the difference between actual and perceived unemployment rates associated with the actual and baseline intended major choices respectively.

[23] Cost is defined as the reduced chance of finding a job, i.e., higher unemployment rate.

Figure 7 shows the share of students whose revision (college major changes) behavior satisfies the following rule:

$$\Delta U_{Actual} - \Delta U_{Perceived} < 0,$$

where U stands for the unemployment rate, and the differences between actual and perceived unemployment rates are defined as follows:

$$\Delta U_{Actual} = U_{Actual}\,(Actual\ Major) - U_{Actual}\,(Baseline\ Intended\ Major)$$

$$\Delta U_{Perceived} = U_{Perceived}\,(Actual\ Major) - U_{Perceived}\,(Baseline\ Intended\ Major)$$

The following rationale explains the students' revision behavior - they learned that they would not be as much at risk of unemployment as they had previously believed if they changed their majors. We find that a higher share of students follows this pattern in the treatment group than in the control group. Coefficient estimates in Table 7 suggest that 20 percent more students in the treatment group revise toward 'lower relative unemployment rate' compared to the control group; the effect is significant at 1 percent.[24] The effect is more pronounced at 30 percent in the sample of eleventh-grade students. Both coefficients remain robust after controlling for the covariates in all model specifications. Unlike with the treatment effect, he 'lower relative unemployment' argument does not explain the effect of indirect provision of information.

Result 3

The revisions are driven by the differences between the perceived and actual unemployment rates across baseline and actual specialization choices. Therefore, changes in

[24] Note that the regression analysis is conducted on the sample of students whose actual college major choices differ from the baseline choices ones.

specialization choices can be explained by the differences between the perceived and actual employment opportunities.

Surprisingly, we find no evidence of earnings explaining changes in the college major choices, i.e., students do not change their specializations toward higher wages.[25] Moreover, we show that students do not change their choices toward majors with higher expected earnings and lower unemployment rates. An extensive analysis of all these channels with reference to appropriate tables and figures can be found in Appendix C.

4. Conclusion

This paper studies the effects of information provision on the college major choices of high school students in Georgia. We find that information strongly affects educational choices – 10 percent more students in the treatment group chose a different college major after information was provided. Interestingly, the treatment effect is more pronounced in the older students. We implement a novel experimental design and contribute to related literature by measuring the effects of indirect information provision. We find that the spillover effect is significant but smaller than the treatment effect. Similarly to the direct treatment effect, indirect provision of the information mainly affects the choices of older students. Our results suggest that both direct and indirect channels of information provision can be used to nudge individuals' behavior. However, from policy perspective, too-early intervention may be ineffective.

We argue that immediate effects of the information may not be translated into real life choices. Our findings indicate that immediate changes in the intended choices are not necessarily linked to the final major choices. Interestingly, only 18 percent of the students who initially

[25] We find no support for this hypothesis: $W_{baseline\ intended\ choices} < W_{actual\ choices}$.

changed their intended choices did so again at the end, i.e., revised their actual college major choices. We conclude that analyzes based on immediate effects may be less informative of the effects of interventions on real-life outcomes. Further research is needed to supplement our findings on the immediate and actual changes in different experimental settings.

Our paper sheds light on the mechanisms through which information affects students' college major choices. We find that the differences between the actual and perceived unemployment rates have significant effects on major choices. This suggests that some students may have initially overestimated the cost of changing their college major, in the form of high unemployment rate. However, upon observing the information, they learned that actual unemployment is lower than they believed and changed their baseline major choice in the end. We do not find any evidence that students revise their choices toward majors associated with higher wages, higher expected earnings, or lower unemployment rates. Further, the differences between the actual and perceived earnings do not explain the revisions.

This study provides information about average wages and unemployment rates for each major, however, in reality, there are other factors that contribute to students' final decisions, not all of which would be measurable or observable. For instance, one could consider designing experiments providing the distribution of salaries and unemployment, opportunities to work or continue studies, or work abroad opportunities, and information on the differences between urban and rural areas. Furthermore, non-pecuniary aspects of the specialization can be highly relevant to the students (Wiswall and Zafar, 2018). These aspects are interesting directions for future research.

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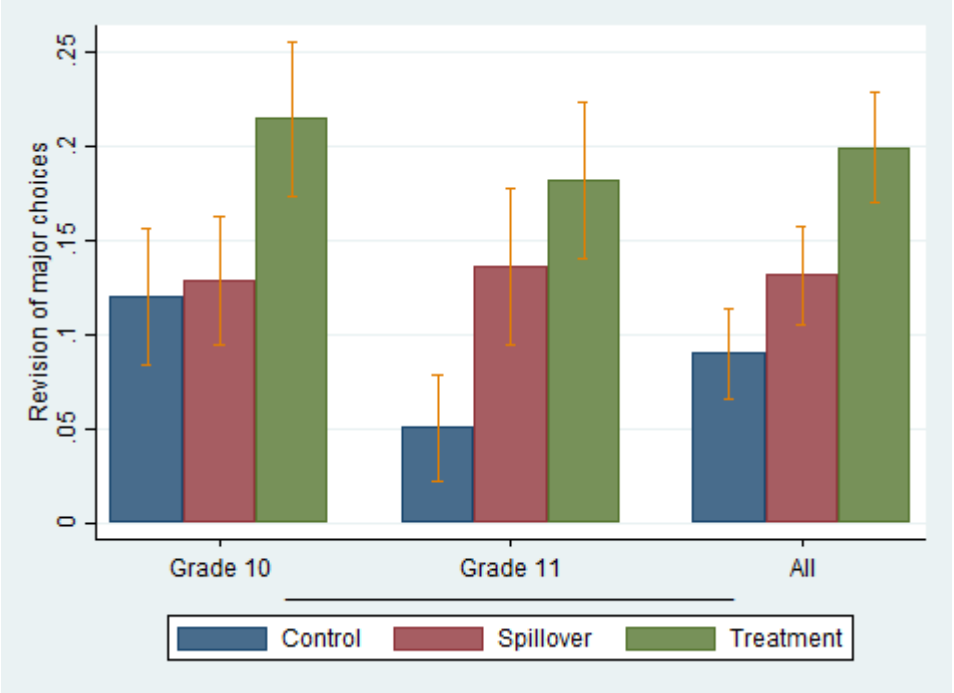
6. Figures and Tables

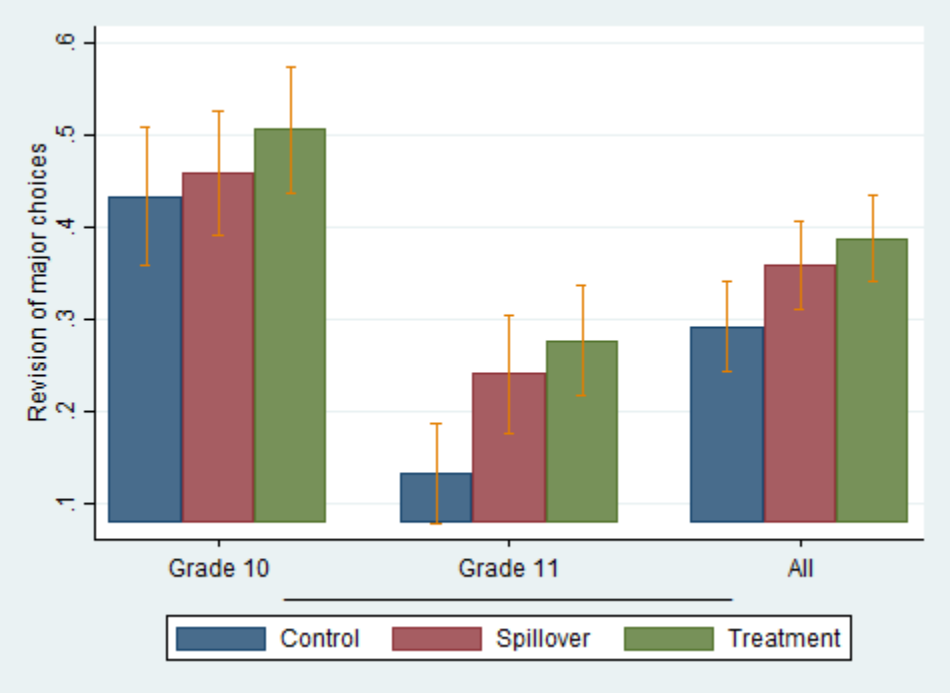
6.1 Figures

Figure 1: Revision of intended college major choices



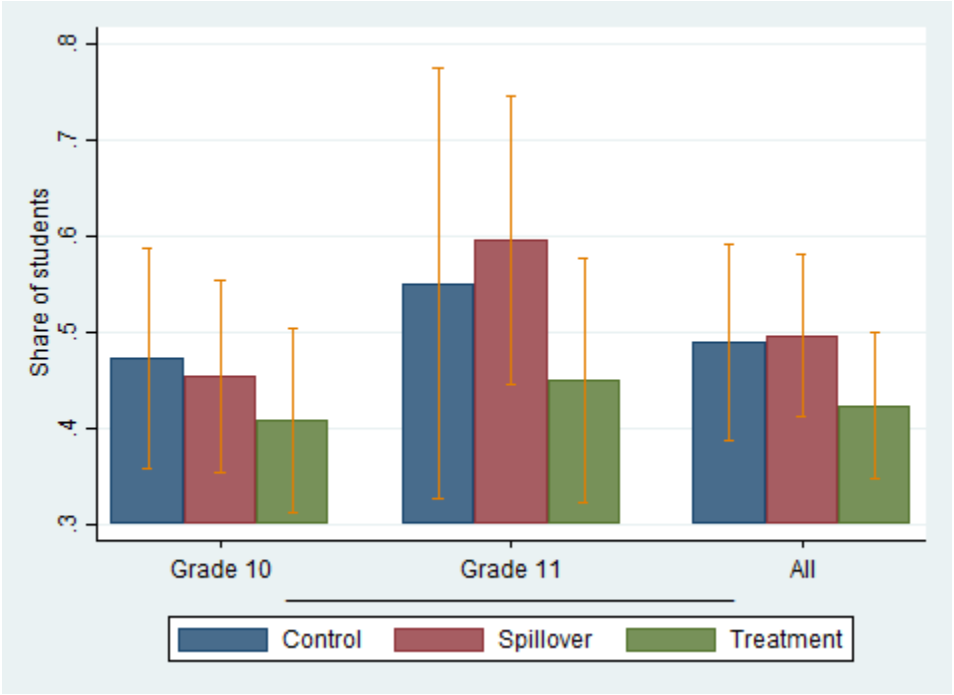
Notes: the figure shows revisions of the intended choices by the control (blue bars), spillover (red bars), and treatment groups (green bars). The revision rate represents the fraction students whose revised intended choices differ from their baseline intended major choices. The revision of the major choices is presented for the tenth grade, eleventh grade, and full sample. We find that students in the treatment group revise their intended major choices more often than do their peers in the control group. The difference is statistically significant at the $p<0.01$ significance level (see Table 4).

Figure 2: Revision of actual college major choices



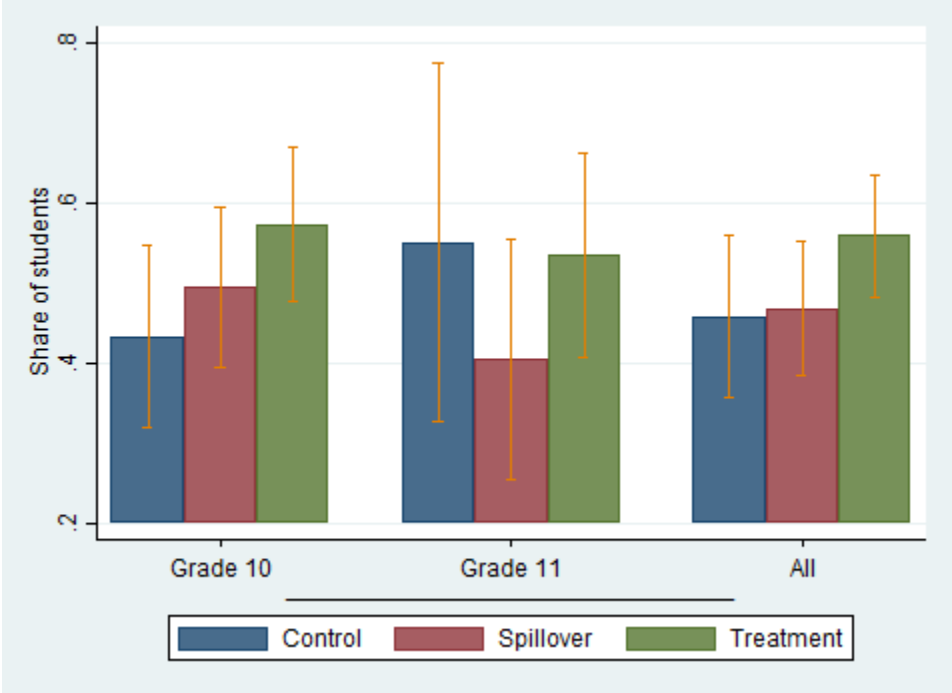
Notes: the figure shows revisions of the actual choices by the control (blue bars), spillover (red bars), and treatment groups (green bars). The revision rate represents the fraction students whose revised actual choices differ from their baseline intended major choices. The revision of the major choices is presented for the tenth grade, eleventh grade, and full sample. We find that students in the treatment group revise their intended major choices more often than do their peers in the control group. The difference is statistically significant at the $p<0.01$ significance level (see Table 5).

Figure 3: Do students revise their actual choices toward college majors associated with higher wages?



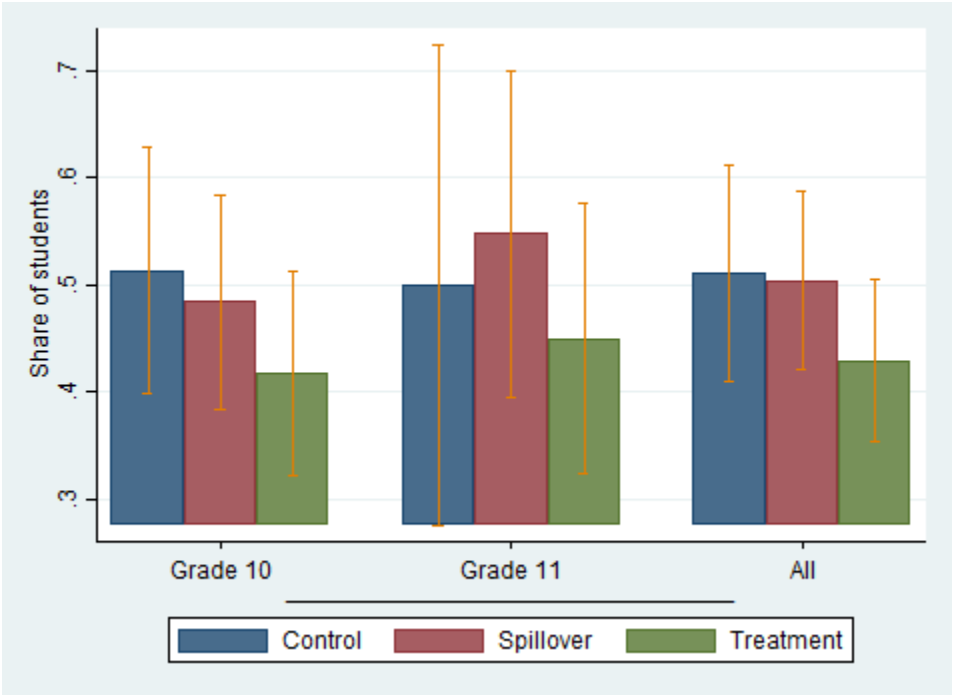
Notes: the figure shows the share of the students who revised their actual major choices toward those associated with higher wages in the control (blue bars), spillover (red bars) and treatment groups (green bars). Note that the actual wages for each major are given in Table 3. The vertical bars represent the share of students for whom the real wage differences between the actual and baseline intended major choices are positive. About 40% of the informed students (treatment group) revise their specialization choices toward majors associated with higher wages – much less than the students in the control group. Indeed, the share of the students who revise their actual major choices toward those associated with higher wages is larger in the control group than in the treatment group. Thus, the treatment effect is negative and statistically insignificant at the $p<0.05$ level for the eleventh-grade students.

Figure 4: Do students revise their actual choices toward college majors associated with lower rates of unemployment?



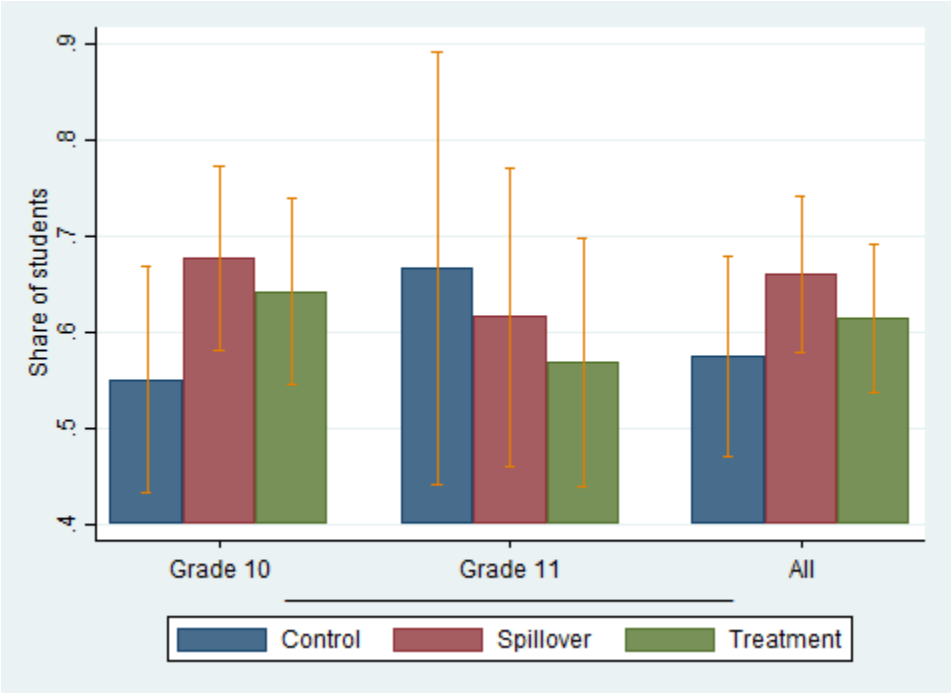
Notes: the figure shows share of the students who revised their actual major choices toward majors associated with lower unemployment rates in the control (blue bars), spillover (red bars), and treatment groups (green bars). Note that the actual unemployment rates for each major are given in Table 3. Nearly 11% more students revise toward majors with lower rates of unemployment in the treatment group than in the control group. Overall, the difference is statistically insignificant at the $p<0.05$ level (see Table 6).

Figure 5: Do students revise their actual choices toward college majors associated with higher expected earnings?



Notes: the figure shows share of the students who revised their actual major choices toward majors associated with higher expected earnings in the control (blue bars), spillover (red bars), and treatment groups (green bars). Expected earnings are calculated as the product of the wage rate and employment rate for each major. The employment rate for each specialization is calculated as one minus the unemployment rate. Note that expected earnings for each major are given in Table 3. Fewer of the informed students (treatment group) revise their specialization choices toward majors with higher expected earnings. By contrast, expected earnings are higher for students who revised in the control group than those in the treatment group. However, the difference is statistically insignificant at $p<0.05$ level (see Table 6).

Figure 6: Revision of actual college choices toward college majors associated with higher relative wages: perceived vs actual wage differences



Notes: the figure shows share of the students who revised their choice toward majors associated with higher relative wages in the control (blue bars), spillover (red bars), and treatment groups (green bars). Relative wage is defined as the difference between actual and perceived wages associated with actual and baseline intended major choices, respectively. Actual wages are the population mean earnings given in Table 3, while the perceived wages are measured in the baseline survey before the provision of the information. The vertical bar shows the share of students whose revision behavior satisfies the following condition:

$$\Delta W_{Actual} - \Delta W_{Perceived} > 0,$$

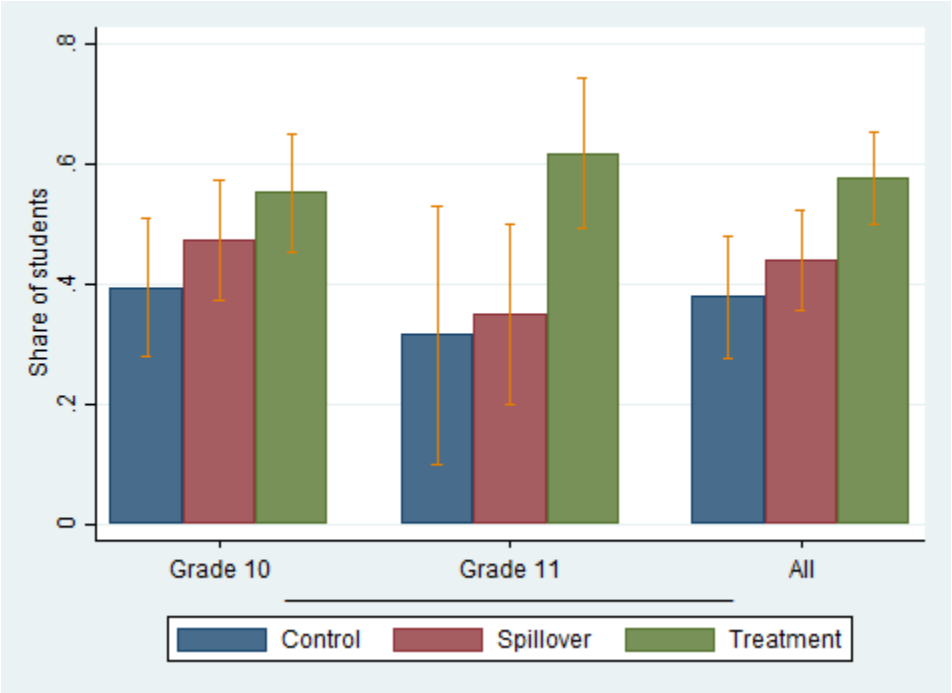
where W stands for the wage and the differences between actual and perceived wages are defined as follows:

$$\Delta W_{Actual} = \frac{W_{Actual}\,(Actual\ Major) - W_{Actual}\,(Baseline\ Major)}{W_{Actual}\,(Baseline\ Choice)}$$

$$\Delta W_{Perceived} = \frac{W_{Perceived}\,(Actual\ Major) - W_{Perceived}\,(Baseline\ Major)}{W_{Perceived}\,(Baseline\ Major)}$$

The following mechanism explains the students' revision behavior - they learned that they would not be likely to face significantly lower earnings by changing their specialization as they had initially perceived. We find that a higher share of students follows this pattern in the treatment group than in the control group, however, this difference is insignificant (see Table 6).

Figure 7: Revision of actual choices toward college major choices associated with lower relative rates of unemployment: perceived vs actual unemployment rate differences



Notes: the figure shows share of students who revise their major toward those associated with lower relative unemployment rate in the control (blue bars), spillover (red bars), and treatment groups (green bars). Relative unemployment rate is defined as the difference between actual and perceived unemployment rates associated with the actual and intended baseline major choices respectively. Actual unemployment rates are the population unemployment rates given in table 3, while the perceived unemployment rates are measured in the baseline survey before the provision of the information. The vertical bar shows the share of students whose revision behavior satisfies the following rule:

$$\Delta U_{Actual} - \Delta U_{Perceived} < 0,$$

where U stands for the unemployment rate and the differences between actual and perceived unemployment rates are defined as follows:

$\Delta U_{Actual} = U_{Actual}\,(Actual\ Major) - U_{Actual}\,(Baseline\ Major)$

$\Delta U_{Perceived} = U_{Perceived}\,(Actial\ Major) - U_{Perceived}\,(Baseline\ Major)$

We find that a higher share of students follows this pattern in the treatment group than those in the control group, i.e., perceived unemployment differences exceed the actual ones. The following mechanism explains the students' revision behavior - they learned that they would not sacrifice much of their employment opportunities by changing their specialization, as they had initially perceived. Overall, 20% more students revise toward lower unemployment rates in the treatment group than in the control group. This difference is statistically significant at p<0.01 level in all model specifications (see Table 7).

6.2 Tables

Table 1: Timeline of the experiment

	Round 1	Round 2	Round 3	
	Baseline Intended Choices *Information Intervention*	Revised Intended Choices	Actual Choices	
	April 2017	May 2017	September 2018	September 2019
	(1)	(2)	(3)	(4)
Grade 10	Yes	Yes	No	Yes
Grade 11	Yes	Yes	Yes	No
Total	2015	1913	543	587

Notes: Columns (1), (2), (3) and (4) report the number of student responses in rounds 1-3. Both tenth-grade and eleventh-grade students were surveyed in May and April 2017. In the baseline survey, twenty students either did not report any specialization choice or selected the 'no university' choice, thus we recorded 1,995 responses with stated college major choices. In the second round, we collected 1,913 revised intended college major choices. Revised intended choices are their updated intended choices. In the third round, we were able to follow-up 543 grade 10 and 587 grade 11 students (1,130 in total) and collect actual major choices.

Table 2: Summary statistics

Table 2.1: Comparison of the means in the *baseline sample*

	Control	Spillover	Treatment	F-test p-value
Age	16.17	16.15	16.21	0.29
	(0.67)	(0.67)	(0.67)	
% of male students	45.6	44.49	47.85	0.43
	(49.85)	(49.73)	(49.99)	
Number of brothers	0.65	0.68	0.62	0.39
	(0.89)	(0.74)	(0.72)	
Number of sisters	0.66	0.59	0.66	0.15
	(0.81)	(0.68)	(0.78)	
% of students having a tutor	79.08	78.5	81.61	0.31
	(40.71)	(41.12)	(38.77)	
% of students having a computer	90.75	91.71	91.92	0.75
	(29)	(28.1)	(27.26)	
Subjective ranking in the school	36.77	35.30	33.82	0.23
	(31.45)	(30.63)	(28.25)	
Beliefs about own earnings[†]	1,174.62	1,070.75	1,074.09	0.23
	(1,342)	(1,127)	(1,114)	
Class Size	17.55	14.61	15.83	0.24
	(6.6)	(14.61)	(7.51)	
Observations	744	672	579	

Notes: Standard deviations are in parentheses beneath mean estimates in columns (1)-(3); Column (4) reports the p-value of an F-test testing the null hypothesis that means are equal across control, spillover, and treatment groups. Data are from the baseline survey of tenth and eleventh grade students, conducted by the authors in April 2017. Control and spillover groups did not receive any information, the treatment group received earnings and unemployment figures. Treatment and spillover groups both represent the treated schools, hence the students from treatment groups could spread the information to their peers in the spillover group.

[†] Beliefs about their own potential earnings are measured in Georgian Lari, GEL and represent the student's expected monthly salaries after university graduation.

Table 2.2: Comparison of means for the major choices and beliefs in the *baseline sample*

Educational Attainment	Baseline Major Choice				Beliefs on Monthly Earnings (GEL)				Beliefs on Unemployment Rate (%)			
	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value
No Uni. Education	NA	NA	NA	NA	373	373	392	0.32	47.51	45.19	45.10	0.04
					(339.45)	(220.23)	(232.78)		(18.48)	(18.84)	(19.18)	
Exact and Natural Sc.	14.51%	15.77%	14.78%	0.80	907	928	1,459	0.16	29.87	30.06	29.47	0.81
	(35.25)	(36.48)	(35.52)		(552.22)	(673.13)	(703.64)		(16.82)	(17.13)	(17.45)	
Medical Sciences	15.54%	15.03%	15.59%	0.95	1,336	1,482	1,459	0.02	24.52	24.96	24.72	0.89
	(36.26)	(35.76)	(36.3)		(878.26)	(1017.88)	(845.91)		(16)	(16.76)	(16.06)	
Econ. and Business	28.84%	28.87%	28.90%	1.00	1,627	1,682	1,760	0.08	27.21	27.38	28.01	0.67
	(45.34)	(45.35)	(45.36)		(928.24)	(1099.79)	(853.15)		(17.16)	(17.5)	(17.26)	
Social Sciences	7.77%	9.52%	7.39%	0.31	1,176	1,206	1,248	0.29	30.61	30.18	29.38	0.44
	(26.8)	(29.38)	(26.18)		(762.68)	(842.03)	(853.15)		(17.51)	(18.03)	(17.8)	
Art and Humanities	13.82%	14.14%	16.40%	0.34	808	832	878	0.05	35.02	33.54	34.34	0.39
	(34.54)	(34.87)	(37.05)		(509.77)	(482.58)	(576.33)		(19.31)	(18.04)	(19.41)	
Law	19.52%	16.67%	16.94%	0.35	1,515	1,498	1,635	0.02	30.11	28.30	28.82	0.22
	(39.67)	(37.3)	(37.53)		(928.17)	(934.68)	(1023.75)		(18.88)	(18.49)	(18.42)	
Obs.	579	672	744		534	649	723		564	666	733	

Notes: Standard deviations are in parentheses beneath mean estimates in columns (1)-(3), (5)-(7) and (9)-(11); Columns (4), (8) and (12) report p-values for a F-test testing the null hypothesis that the means are equal for all three groups. Data are from the baseline survey of tenth and eleventh grade students, conducted by the authors in April 2017.

Table 2.3: Comparison of means for the parental education in the *baseline sample*

Educational Attainment	**Mother's Education**				**Father's Education**			
	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value
No Uni. Education	6.22%	6.11%	5.94%	0.98	1.58%	3.93%	3.51%	0.04
	(24.17)	(23.97)	(23.65)		(12.48)	(19.44)	(18.42)	
Exact and Natural Sc.	11.05%	11.33%	11.34%	0.98	32.28%	26.74%	28.11%	0.09
	(31.38)	(31.72)	(31.72)		(46.8)	(44.29)	(44.98)	
Medical Sciences	24.18%	25.34%	26.45%	0.64	5.26%	4.98%	6.08%	0.64
	(42.85)	(43.53)	(44.14)		(22.35)	(21.78)	(23.91)	
Econ. and Business	17.79%	18.93%	14.71%	0.09	22.63%	22.51%	22.03%	0.96
	(38.28)	(39.2)	(35.44)		(41.88)	(41.79)	(41.47)	
Social Sciences	12.78%	11.18%	14.98%	0.10	19.65%	21.00%	18.65%	0.54
	(33.42)	(31.53)	(35.71)		(39.77)	(40.76)	(38.98)	
Art and Humanities	24.18%	22.95%	19.70%	0.12	8.07%	8.46%	8.38%	0.97
	(42.85)	(42.08)	(39.8)		(27.26)	(27.85)	(27.73)	
Law	3.97%	4.17%	6.88%	0.02	10.53%	12.39%	13.24%	0.32
	(19.55)	(20.01)	(25.33)		(30.72)	(32.97)	(33.92)	
Obs.	579	671	741		570	662	740	

Notes: Standard deviations are in parentheses beneath mean estimates in columns (1)-(3), (5)-(7); Columns (4) and (8) report p-values for a F-test testing the null hypothesis that the means are equal for all three groups. Data are from the baseline survey of tenth and eleventh grade students, conducted by the authors in April 2017.

Table 2.4: Comparison of the means: school characteristics

School Characteristics	Control Schools	Treated Schools	t-test *p-value*
Total number of students	1693.97	1553.33	0.58
	(671.62)	(482.83)	
Total number of teachers	106	98	0.60
	(44.11)	(26.8)	
% of Schools located in the city center	33.12	38.08	0.75
	(18.37)	(39.04)	
Class size	21.95	18.60	0.17
	(13.58)	(8.81)	
Observations	7	15	

Notes: Standard deviations are in parentheses beneath mean estimates in columns (1)-(2); Column (3) reports p-values for a t-test testing the null hypothesis that the means are equal for all three groups. The data cover the schools where the experiment was carried out in April 2017. The data on the total number of students and teachers were retrieved from the website of the Georgia Ministry of Education in 2017. The data on locations and class sizes were collected by the authors.

Table 3: Actual vs perceived earnings and unemployment rates in the *baseline sample*

Educational Attainment	Mean Earnings			Unemployment Rate			Expected Earnings		
	Actual	Belief	Bias	Actual	Belief	Bias	Actual	Belief	Bias
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
No University Education	504	381	-25%	8.3%	46%	450%	462	206	-55%
Tertiary Education	802	1,280	60%	13.1%	29%	123%	697	921	31%
Exact and Natural Sciences	771	940	22%	12.6%	30%	137%	673	660	-2%
Medical Sciences	673	1,432	113%	10%	25%	149%	606	1,078	78%
Economics and Business	890	1,696	91%	19.2%	28%	43%	719	1,229	71%
Social Sciences	872	1,213	39%	13.3%	30%	125%	756	849	12%
Art and Humanities	654	843	29%	8.5%	34%	303%	599	554	-7%
Law	953	1,555	63%	15.1%	29%	92%	809	1,104	36%

Notes. Columns (1)-(2) report the actual and perceived mean monthly earnings in Georgia. Columns (4)-(5) report the actual and perceived unemployment rates. Columns (7)-(8) report the expected monthly earnings calculated as the product of mean monthly earnings and employment rates. Employment rates are calculated as one minus the unemployment rate. Both actual and perceived earnings are given in Georgian Lari, and the average exchange rate in 2017 was approximately $1=2.4 GEL. Mean monthly earnings and unemployment rates for individuals with tertiary education are calculated as the weighted average earnings and unemployment rates of individuals having a degree in one of the majors: exact and natural sciences, medical sciences, economics and business administration, social sciences, arts and humanities, and law. Columns (3), (6) and (9) calculate the difference between the perceived and actual figures in percentage terms. The bias is calculated as follows: $Bias = \frac{Belief - Actual}{Actual} * 100$. Actual earnings and unemployment rates are calculated using the 2015 Household Survey conducted by the National Statistics Office of Georgia. For the calculation of earnings, we considered only full-time employees. Unemployment rates are defined in line with the International Labor Organization (ILO) strict criteria (see page 6). https://ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_675155.pdf

Table 4: Revision of intended college major choices

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.11***	0.13***	0.10***	0.12***	0.10***	0.16***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)
Spillover	0.04**	0.09***	0.04*	0.09***	0.05**	0.13***
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)
Grade10		0.07**	0.04**	0.10***	0.04**	0.13***
		(0.03)	(0.02)	(0.02)	(0.02)	(0.04)
Treatment ×		-0.04		-0.04		-0.09**
Grade10		(0.04)		(0.04)		(0.04)
Spillover ×		-0.08*		-0.10***		-0.13***
Grade10		(0.04)		(0.03)		(0.04)
Covariates†	No	No	Yes	Yes	Yes	Yes
Constant	0.09***	0.05**	0.01	-0.01		
	(0.01)	(0.02)	(0.05)	(0.06)		
Observations	1,913	1,913	1,668	1,668	1,668	1,668
R^2	0.02	0.02	0.04	0.04		

Notes: (1)-(4) Linear probability models, (5)-(6) probit models (marginal effects). Sample: 10th and 11th grade students who reported their intended major choices. Dependent variable: categorical variable coded 1 if a student's revised intended major choice differs from her/his baseline intended college major choice. Standard errors in parentheses. Robust standard errors clustered by class for the linear probability models. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

† Covariates: gender, age, beliefs on population earnings and unemployment rate by specialization, beliefs about personal earnings upon university graduation, baseline intended specialization choice, number of siblings, a dummy variable indicating whether a student has a private tutor, beliefs about their own ranking, parental education, class size.

Table 5: Revision of actual college major choices

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.10***	0.14***	0.09**	0.14***	0.09**	0.16***
	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)
Spillover	0.07*	0.11**	0.04	0.12***	0.04	0.14***
	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Grade10		0.30***	0.26***	0.35***	0.25***	0.36***
		(0.05)	(0.03)	(0.05)	(0.03)	(0.07)
Treatment ×		-0.07		-0.09		-0.13
Grade10		(0.07)		(0.07)		(0.08)
Spillover ×		-0.08		-0.15**		-0.17**
Grade10		(0.07)		(0.07)		(0.09)
Covariates†	No	No	Yes	Yes	Yes	Yes
Constant	0.29***	0.13***	0.25**	0.20**		
	(0.03)	(0.04)	(0.1)	(0.09)		
Observations	1,130	1,130	995	995	995	995
R^2	0.01	0.07	0.1	0.11		

Notes: (1)-(4) Linear probability models, (5)-(6) probit models (marginal effects). Sample: 10th and 11th grade students who reported their actual major choices. Dependent variable: categorical variable coded 1 if a student's actual major choice differs from her/his baseline intended college major choice. Standard errors in parentheses. Robust standard errors clustered by class for the linear probability models. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

† Covariates: gender, age, beliefs on population earnings and unemployment rate by specialization, beliefs about personal earnings upon university graduation, first round reported specialization choice, number of siblings, a dummy variable indicating whether a student has a private tutor, beliefs about their own ranking, parental education, class size.

Table 6: Determinants of actual college major choice revisions: wage, unemployment rate, expected earnings and relative wages

	Actual Wage		Actual Unemployment Rate		Actual Expected Earnings		Relative Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-0.07	-0.1	0.1	-0.02	-0.08	-0.05	-0.03	-0.12
	(0.06)	(0.13)	(0.06)	(0.13)	(0.06)	(0.13)	(0.07)	(0.13)
Spillover	0.01	0.05	0.01	-0.15	-0.01	0.05	0.05	-0.11
	(0.07)	(0.14)	(0.07)	(0.14)	(0.07)	(0.14)	(0.07)	(0.14)
Grade10		-0.08		-0.12		0.01		-0.17
		(0.13)		(0.13)		(0.13)		(0.13)
Treatment ×		0.03		0.16		-0.05		0.09
Grade10		(0.15)		(0.15)		(0.15)		(0.15)
Spillover ×		-0.06		0.21		-0.08		0.2
Grade10		(0.16)		(0.16)		(0.16)		(0.16)
Constant	0.49***	0.55***	0.46***	0.55***	0.51***	0.50***	0.59***	0.72***
	(0.05)	(0.11)	(0.05)	(0.11)	(0.05)	(0.11)	(0.05)	(0.12)
Observations	396	396	396	396	396	396	372	372
R^2	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Notes: Linear probability models. Sample: 10th and 11th grade students whose actual major choices differ from their baseline intended major choices. Dependent variable: (1)-(2) a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a higher wage, and 0 otherwise; (3)-(4) a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a lower unemployment rate, and 0 otherwise; (5)-(6) a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a higher expected earning, and 0 otherwise; (7)-(8) a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a relatively higher wage, and 0 otherwise. Standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2 displays the same analysis with the dependent variable being *the differences* in actual wages, unemployment rates, expected earnings and relative wages. Table A3 displays the same analysis with the dependent variable being *the percentage differences* in actual wages, unemployment rates, expected earnings and relative wages.

Table 7: Determinants of actual college major choice revisions: relative unemployment rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	0.20***	0.30**	0.24***	0.40***	0.06***	0.05*	0.08***	0.07**
	(0.07)	(0.13)	(0.06)	(0.12)	(0.02)	(0.03)	(0.02)	(0.03)
Spillover	0.06	0.03	0.10*	0.06	0.01	-0.01	0.01	-0.02
	(0.07)	(0.14)	(0.06)	(0.14)	(0.02)	(0.03)	(0.02)	(0.03)
Grade10		0.08	0.14	0.22		-0.02	0	-0.03
		(0.13)	(0.1)	(0.14)		(0.03)	(0.02)	(0.02)
Treatment × Grade10		-0.14		-0.24*		0.01		0.02
		(0.15)		(0.13)		(0.04)		(0.04)
Spillover × Grade10		0.05		0.07		0.04		0.06
		(0.16)		(0.14)		(0.04)		(0.04)
Covariates†	No	No	Yes	Yes	No	No	Yes	Yes
Constant	0.38***	0.32***	0.04	-0.06				
	(0.05)	(0.11)	(0.21)	(0.23)				
Observations	385	385	334	334	1,119	1,119	995	995
R^2	0.03	0.03	0.18	0.2				

Notes: (1)-(4) Linear probability models. Sample: 10th and 11th grade students whose actual major choices differ from the baseline intended major choices. Dependent variable: a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a *relatively* lower unemployment rate, and 0 otherwise. Standard errors in parentheses: robust standard errors clustered by school. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

(5)-(8) Ordered probit models, marginal effects for switching toward lower relative unemployment rate. Sample: 10th and 11th grade students who reported their actual major choices. Dependent variable: a categorical variable coded 1 if a student changed her/his specialization choice toward one associated with a *relatively* lower unemployment rate, -1 if a student changed her/his specialization toward one associated with a relatively higher unemployment rate, and 0 if a student did not change her/his specialization. The table reports marginal effects only for switching toward a major associated with lower relative unemployment rate

† Covariates: gender, age, beliefs about personal earnings upon university graduation, first round reported specialization choice, number of siblings, a dummy variable indicating whether a student has a private tutor, beliefs about their own ranking, parental education, class size.

7. Appendix

7.1 Appendix A

Table A1: Offered places and demand for college majors

Educational Program	Offered Places	1st choice	1st choice (%)
	(1)	(2)	(3)
Exact and Natural Sciences	10,868	9,550	23.56%
Medical Sciences	2,917	3,264	8.05%
Economics and Business	14,575	8,807	21.73%
Social Sciences	4,267	2,314	5.71%
Arts and Humanities	10,955	11,413	28.16%
Law	6,121	5,182	12.79%
Total	49,703	40,530	

Notes: the table shows the supply of each specialization (offered places) by accredited universities in Georgia and the demand for each major (first desired choice stated by the applicants) in 2017. Column (1) reports the maximum number of places offered by the accredited universities in Georgia. Column (2) reports the number of applicants willing to continue their studies with a given major choice. Column (3) reports the demand for each major in percentage terms. Note that top ranked universities are highly selective and competition is high, although the overall number of offered places exceed the demand. Columns (1) and (2) are constructed based on the information provided by NAEC.

Table A2: Determinants of actual college major choice revisions: differences in wages, unemployment rates, expected earnings and relative wages

	Actual Wage		Actual Unemployment Rate		Actual Expected Earnings		Relative Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-10.92	17.72	-0.94	0.72	-1.51	10.45	-108.02	47.15
	(22.46)	(44.9)	(0.81)	(1.63)	(14.59)	(29.17)	(167.02)	(336.34)
Spillover	25.71	63.68	0.09	1.79	21.8	41.08	109.98	155.44
	(23.16)	(47.24)	(0.84)	(1.71)	(15.04)	(30.69)	(171.77)	(355.21)
Grade10		39.24		1.74		20.46		242.57
		(43.82)		(1.59)		(28.47)		(329.93)
Treatment × Grade10		-35.68		-2.19		-13.9		-182.64
		(52.13)		(1.89)		(33.87)		(389.87)
Spillover × Grade10		-49.38		-2.22		-25		-34.03
		(54.33)		(1.97)		(35.3)		(406.7)
Constant	-3.88	-34.77	0.48	-0.89	-7.15	-23.26	246.06*	53.68
	(17.89)	(38.88)	(0.65)	(1.41)	(11.62)	(25.26)	(133.36)	(293.82)
Observations	396	396	396	396	396	396	372	372
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Notes: OLS in all columns. Sample: 10th and 11th grade students whose actual major choices differ from their baseline major choices. Dependent variable: (1)-(2) the actual wage difference between the actual and baseline major choices; (3)-(4) the actual unemployment rate difference between the actual and baseline major choices; (5)-(6) the actual expected earnings difference between the actual and baseline major choices; (7)-(8) the relative wage difference between the actual and baseline major choices. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Determinants of actual college major choice revisions: percentage differences in wages, unemployment rates, expected earnings and relative wages

	Actual Wage		Actual Unemployment Rate		Actual Expected Earnings		Relative Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-1.22	2.65	-4.2	4.95	-0.31	1.88	-8.2	-9.4
	(2.92)	(5.84)	(6.71)	(13.41)	(2.14)	(4.28)	(16.15)	(32.59)
Spillover	3.23	8.04	1.94	10	3.08	6.27	13.18	10.93
	(3.02)	(6.15)	(6.92)	(14.11)	(2.21)	(4.5)	(16.61)	(34.42)
Grade10		5.62		11.22		3.63		-2.61
		(5.7)		(13.09)		(4.18)		(31.97)
Treatment ×		-4.74		-11.72		-2.57		1.2
Grade10		(6.79)		(15.57)		(4.97)		(37.78)
Spillover ×		-6.17		-10.11		-4.09		2.87
Grade10		(7.07)		(16.23)		(5.18)		(39.41)
Constant	0.32***	0.32***	0.32***	0.32***	0.32***	0.32***	0.32***	0.32***
	(2.33)	(5.06)	(5.34)	(11.61)	(1.7)	(3.71)	(12.9)	(28.47)
Observations	396	396	396	396	396	396	372	372
R^2	0.01	0.01	0	0	0.01	0.01	0.01	0.01

Notes: OLS in all columns. Sample: 10th and 11th grade students whose actual major choices differ from their baseline major choices. Dependent variable: (1)-(2) the actual wage difference (in %) between the actual and baseline intended major choices; (3)-(4) the actual unemployment rate difference (in %) between the actual and baseline intended major choices; (5)-(6) the actual expected earnings difference (in %) between the actual and baseline intended major choices; (7)-(8) the relative wage difference in (%) between the actual and baseline intended major choices. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Do baseline beliefs predict changes in the major choices?

	Actual major choices		Baseline intended major choices	
	(1)	(2)	(3)	(4)
Treatment	0.0818*	0.0927*	0.14***	0.12***
	(0.05)	(0.05)	(0.03)	(0.02)
Spillover	0.03	0.00	0.07**	0.06***
	(0.05)	(0.06)	(0.03)	(0.02)
Unemp. Bias[a]	0.000	0.001	0.002**	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)
Treatment ×	0.001	-0.000	-0.002*	-0.002
Unemp. Bias	(0.00)	(0.00)	(0.00)	(0.00)
Spillover ×	0.003	0.003	-0.002	-0.002
Unemp. Bias	(0.00)	(0.00)	(0.00)	(0.00)
Covariates[b]	No	Yes	No	Yes
Constant	0.2843***	0.2776***	0.063***	0
	(0.03)	(0.1)	(0.02)	(0.05)
Observations	1,108	995	1881	1668
R^2	0.01	0.11	0.02	0.04

Notes: Linear probability models. (1)-(2) Sample: 10th and 11th grade students who reported their actual major choices. The dependent variable: a categorical variable coded 1 if a student's actual major choice differs from the baseline intended choice. (3)-(4) Sample: 10th and 11th grade students who reported their intended major choices. Dependent variable: a categorical variable coded 1 if a student's intended major choice differs from the baseline one. Robust standard errors clustered by class in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

[a] *Unemp. Bias*: variable Unemployment bias is defined as a difference between the perceived and true unemployment rate (in percentage points) for the baseline college major. Note that the beliefs were elicited before the leaflet was provided. *Unemp. Bias* × *Treatment* (*Unemp. Bias* × *Spillover)* stands for the interaction term between the unemployment bias and the Treatment (Spillover) dummy variable.

[b] Covariates: gender, age, beliefs about personal earnings upon university graduation, baseline college major choice, number of siblings, a dummy variable indicating whether a student has a private tutor, beliefs about their own ranking, parental education, class size.

Table A5: Comparison of the means in the *attrition sample*

Educational Attainment	Baseline Intended Major Choice				Beliefs on Monthly Earnings (GEL)				Beliefs on Unemployment Rate (%)			
	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value
No Uni. Education	NA	NA	NA	NA	350	374	356	0.35	48.28	43.89	44.32	0.01
					(214.22)	(212.01)	(187.01)		(17.81)	(19.47)	(19.55)	
Exact and Natural Sc.	14.79%	15.79%	14.86%	0.93	832	884	1,288	0.50	30.08	29.47	27.73	0.21
	(35.57)	(36.53)	(35.63)		(469.2)	(612.43)	(621.19)		(16.92)	(16.83)	(16.58)	
Medical Sciences	15.95%	15.09%	15.48%	0.96	1,205	1,405	1,288	0.03	24.17	24.10	24.32	0.99
	(36.69)	(35.86)	(36.23)		(768.64)	(977.05)	(739.62)		(15.24)	(16.38)	(16.09)	
Econ. and Business	29.18%	28.07%	28.79%	0.96	1,571	1,695	1,593	0.30	27.15	27.81	27.62	0.90
	(45.55)	(45.01)	(45.35)		(894.95)	(1062.39)	(810.97)		(16.82)	(18.15)	(16.85)	
Social Sciences	7.78%	10.18%	6.81%	0.31	1,095	1,121	1,137	0.82	30.00	30.32	28.90	0.58
	(26.84)	(30.29)	(25.23)		(726.45)	(773.9)	(810.97)		(16.86)	(17.79)	(18.19)	
Art and Humanities	13.62%	14.04%	17.03%	0.44	774	785	835	0.31	35.14	33.01	32.51	0.23
	(34.37)	(34.8)	(37.65)		(493.33)	(407.05)	(588.93)		(19.88)	(17.77)	(19.29)	
Law	18.68%	16.84%	17.03%	0.83	1,405	1,431	1,504	0.37	30.10	27.43	27.38	0.16
	(39.05)	(37.49)	(37.65)		(838.48)	(819.37)	(933.14)		(19.32)	(18.88)	(18.61)	
Obs.	257	285	323		231	273	316		252	283	320	

Notes: Sample: 10th and 11th grade students who were present in the baseline survey but have not reported their actual college major choices. Standard deviations are in parentheses beneath mean estimates in columns (1)-(3), (5)-(7) and (9)-(11); Columns (4), (8) and (12) report p-values for a F-test testing the null hypothesis that the means are equal for all three groups. Data are from the survey of tenth and eleventh grade students who were present in the baseline survey round, but have not reported their actual choices throughout the final stage of the survey.

Table A6: Revision of the intended college major choices in the *actual choices sample*

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.06***	0.06*	0.05**	0.05	0.05**	0.06
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)
Spillover	0.01	0.06*	0.00	0.06**	0	0.07*
	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.04)
Grade10		0.07**	0.05**	0.08**	0.05***	0.09**
		(0.03)	(0.02)	(0.03)	(0.02)	(0.04)
Treatment ×		0.02		0.02		-0.01
Grade10		(0.04)		(0.05)		(0.05)
Spillover ×		-0.10**		-0.10**		-0.12**
Grade10		(0.04)		(0.04)		(0.05)
Covariates [a]	No	No	Yes	Yes	Yes	Yes
Constant	0.06***	0.03	0.00	-0.01		
	(0.02)	(0.02)	(0.05)	(0.06)		
Observations	1,130	1,130	995	995	995	995
R^2	0.01	0.02	0.04	0.05		

Notes: (1)-(4) Linear probability models, (5)-(6) probit models (marginal effects). Sample: 10th and 11th grade students who reported their actual major choices. Note that this table is identical to Table 4 with the difference of the sample. This table analyzes the intended choices of the students who reported their college major choices on all three occasions: in the *baseline* survey*; intended choice*s survey and *actual choices* survey. Dependent variable: categorical variable coded 1 if a student's revised intended major choices differs from her/his baseline intended major choice. Robust standard errors in parentheses. Robust standard errors clustered by class for the linear probability models. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

[a] Covariates: gender, age, beliefs on population earnings and unemployment rate by specialization, beliefs about personal earnings after university graduation, baseline intended specialization choice, number of siblings, having a private tutor, beliefs about their own ranking, parental education, class size.

Table A7: Is attrition correlated with the treatment or spillover?

	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	-0.01	-0.02	0.03	0.03	0.03	0.03
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)
Spillover	-0.02	-0.03	0	0.03	0	0.03
	(0.03)	(0.04)	(0.04)	(0.05)	(0.03)	(0.05)
Grade10		0.10**	0.11***	0.13***	0.11***	0.13**
		(0.04)	(0.03)	(0.05)	(0.03)	(0.06)
Treatment ×		0.03		0		0
Grade10		(0.06)		(0.06)		(0.08)
Spillover ×		0.01		-0.05		-0.05
Grade10		(0.06)		(0.06)		(0.07)
Covariates [a]	No	No	Yes	Yes	Yes	Yes
Constant	0.42***	0.36***	0.28***	0.27***		
	(0.02)	(0.03)	(0.07)	(0.07)		
Observations	1,913	1,913	1,668	1,668	1,668	1,668
R^2	0	0.01	0.05	0.05		

Notes: (1)-(4) Linear probability models, (5)-(6) probit models (marginal effects). Sample: 10th and 11th grade students who reported their revised intended major choices. Dependent variable: categorical variable coded 1 if a student's actual major choice is missing (attrition) and 0 otherwise. Robust standard errors in parentheses. Robust standard errors clustered by class for the linear probability models. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

[a] Covariates: gender, age, beliefs on population earnings and unemployment rate by specialization, beliefs about personal earnings after university graduation, baseline intended specialization choice, number of siblings, having a private tutor, beliefs about own ranking, parental education, class size.

Table A8. Comparison of the means in the *actual choices sample*

Educational Attainment	Baseline Major Choice				Beliefs on Monthly Earnings (GEL)				Beliefs on Unemployment Rate (%)			
	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value	Control	Spillover	Treatment	F-test p-value
No Uni. Education	NA	NA	NA	NA	392	373	351	0.17	46.89	46.15	45.70	0.70
					(409.45)	(226.29)	(225.62)		(19.01)	(18.33)	(18.89)	
Exact and Natural Sc.	14.29%	15.76%	14.73%	0.85	964	959	1,333	0.09	29.70	30.49	30.83	0.68
	(35.05)	(36.49)	(35.48)		(602.45)	(713.12)	(643.19)		(16.76)	(17.35)	(18)	
Medical Sciences	15.22%	14.99%	15.68%	0.96	1,436	1,537	1,333	0.01	24.80	25.60	25.03	0.80
	(35.97)	(35.74)	(36.4)		(942.42)	(1044.31)	(778.07)		(16.61)	(17.03)	(16.06)	
Econ. and Business	28.57%	29.46%	28.98%	0.97	1,670	1,673	1,577	0.33	27.26	27.07	28.31	0.56
	(45.25)	(45.64)	(45.42)		(952.04)	(1127.48)	(733.42)		(17.46)	(17.02)	(17.59)	
Social Sciences	7.76%	9.04%	7.84%	0.77	1,237	1,267	1,113	0.02	31.11	30.07	29.74	0.58
	(26.8)	(28.72)	(26.91)		(784.89)	(884.21)	(733.42)		(18.03)	(18.23)	(17.51)	
Art and Humanities	13.98%	14.21%	15.91%	0.71	833	866	756	0.01	34.92	33.94	35.76	0.40
	(34.73)	(34.96)	(36.62)		(521.31)	(528.67)	(454.54)		(18.87)	(18.26)	(19.41)	
Law	20.19%	16.54%	16.86%	0.38	1,600	1,547	1,446	0.10	30.12	28.94	29.95	0.64
	(40.2)	(37.2)	(37.49)		(984.17)	(1008.42)	(912.47)		(18.56)	(18.2)	(18.21)	
Obs.	322	387	421		303	376	407		312	383	413	

Notes: Sample: 10th and 11th grade students who reported their actual major choices. Standard deviations are in parentheses beneath mean estimates in columns (1)-(3), (5)-(7) and (9)-(11); Columns (4), (8) and (12) report p-values for a F-test testing the null hypothesis that the means are equal for all three groups. Data are from the survey of tenth and eleventh grade students who reported their actual major choices.

7.2 Appendix B

Appendix B1: College major fields (as seen by respondents)

1. Exact and Natural Sciences: Mathematics, Computer Science, Physics, Chemistry, Biology, Biochemistry, Geography, Geology, Ecology, Electrical and Mechanical Engineering, Transportation, Agriculture.

2. Medical Sciences: Medicine, Pharmacy, Dentistry, Public Health.

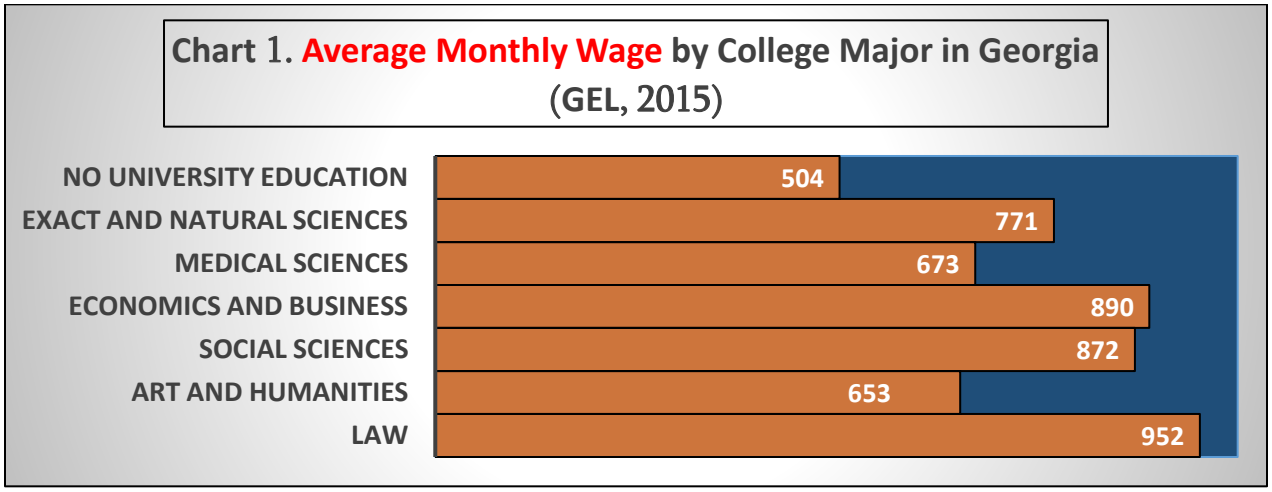
3. Economics and Business: Economics, Business Administration, Tourism, Management, Marketing, Accounting.

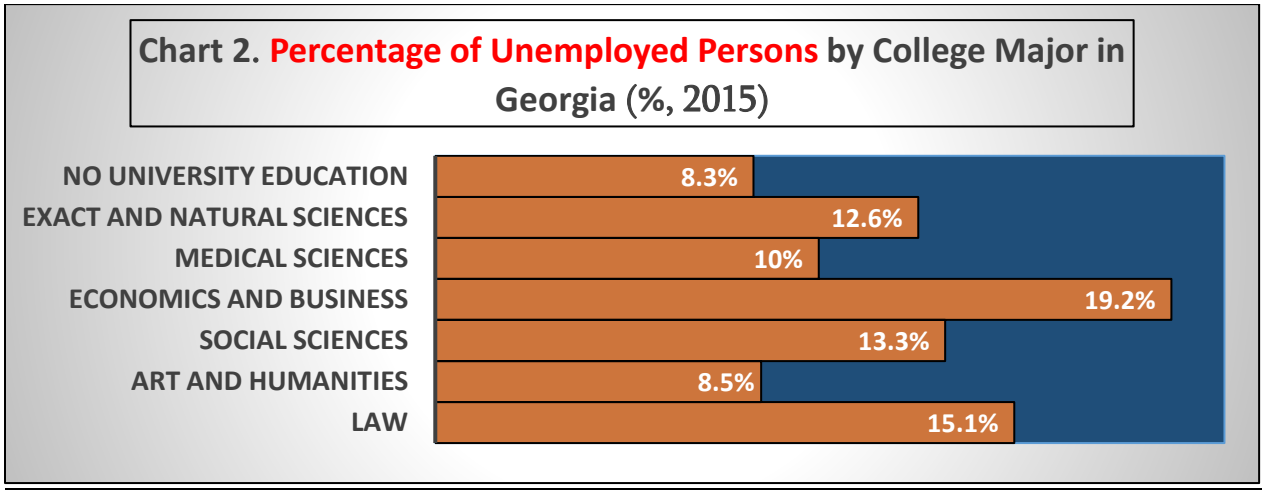
4. Social Sciences: Sociology, Politics, Journalism, Media and Communication, Political Studies, International Relations.

5. Art and Humanities: Philosophy, History, Archeology, Ethnology, Cultural Studies, Art History, Language Studies, Pedagogical Studies, Sports, Drama, Choreography.

6. Law: International Law, Public Law, Criminal Law, Civil Law.

Appendix B2: Information leaflet[26]





[26] All the information is based on data retrieved from the Georgian National Statistical Office (2015). This leaflet was translated from Georgian by the authors.

Information about the Charts on the Leaflet

Chart 1 Shows average monthly wages of full-time employed persons for each college major in Georgia

Chart 1 should be read as follows:

- In Georgia, full-time employed Persons with ***no university degree***, on average, earn ***504 GEL per month***
- In Georgia, full-time employed Persons with a ***university diploma in exact and natural sciences***, on average, earn ***771 GEL per month***
- In Georgia, full-time employed Persons with ***a university diploma in medical sciences***, on average, earn ***673 GEL per month***
- In Georgia, full-time employed Persons with a ***university diploma in economics and business administration***, on average, earn ***890 GEL per month***
- In Georgia, full-time employed Persons with a ***university diploma in social sciences***, on average, earn ***872 GEL per month***
- In Georgia, full-time employed Persons with a ***university diploma in art and humanities***, on average, earn ***654 GEL per month***
- In Georgia, full-time employed Persons with a ***university diploma in law***, on average, earn ***952 GEL per month***

Chart 2 the percent of unemployed persons by university major in Georgia

An unemployed person is defined as a person aged 15 or older, who:
a) has not been employed during a given week
b) has actively sought employment in the prior four weeks
c) is available to start a job within next two weeks

Chart 2 should be read as follows**:**

- In Georgia, ***8.3%*** of persons with ***no university degree*** are unemployed
- In Georgia, ***12.6%*** of persons with a ***university diploma in exact and natural sciences*** are unemployed
- In Georgia, ***10%*** of persons with a ***university diploma in medical sciences*** are unemployed
- In Georgia, ***19.2%*** of persons with a ***university diploma in economics and business administration*** are unemployed
- In Georgia, ***13.3%*** of persons with a ***university diploma in social sciences*** are unemployed
- In Georgia, ***8.5%*** of persons with a ***university diploma in art and humanities*** are unemployed
- In Georgia, ***15.1%*** of persons with a ***university diploma in law*** are unemployed

Appendix B3: Survey Questionnaire[27]

Round 1 (Baseline Intended College Major Choices)

Please read each question and respond carefully. Depending on your response to Question 2, we will provide you with detailed information on:

- The university admission process for the college major *of your choice*
- The competitiveness of the college major *of your choice*
- Any international exchange programs available for the college major *of your choice*

There are four questions. Please respond to all the questions. If any question is unclear, please raise your hand.

1. Are you planning to apply to a university upon graduating from high school?
   - ☐ Yes
   - ☐ No

The following questions pertain to your college major choice. A detailed description of each major can be found in appendix A1. From the list below, please select your top desired college major choice. Note that, based on your college major choice, we will provide you with detailed information on the university admission process, competitiveness (number of applications vs offered places), and availability of exchange programs.

2. Please select your top desired college major from the list below. Please select only one major.
   - ☐ Exact and Natural Sciences
   - ☐ Medical Studies
   - ☐ Economics and Business Administration
   - ☐ Social Sciences
   - ☐ Arts and Humanities
   - ☐ Law

The following questions pertain to **your opinions** about earnings and unemployment for each major.

[27] Translated from Georgian by the authors.

3. In your opinion, among all individuals with a university diploma, what is the average amount that you believe these workers currently earn per month from full-time hired employment?

   Example: In Georgia, a person with a university diploma in Medical Studies earns, on average, X GEL per month from full-time hired employment.

College Major	Average Monthly Salary from Full-time Hired Employment in Georgia (GEL)
Exact and Natural Sciences	
Medical Studies	
Economics and Business Administration	
Social Sciences	
Arts and Humanities	
Law	

4. In your opinion, among all individuals with a university diploma, what is the percentage of unemployed individuals for each specialization?
   An unemployed person is defined as a person aged 15 or older, who:
   a) has not been employed during a given week
   b) has actively sought employment during in the prior four weeks
   c) is available to start a job within next two weeks

   Example: In Georgia, X% of persons with a university diploma in Arts and Humanities is unemployed.

College Major	Unemployment Rate (%)
Exact and Natural Sciences	
Medical Studies	
Economics and Business Administration	
Social Sciences	
Arts and Humanities	
Law	

Post-Experimental Questionnaire

1. Do you have a laptop or personal computer at home?

   ☐ Yes
   ☐ No

2. How many siblings do you have?

   Number of Sister(s): _____ Number of Brother(s): _____

3. What college major does your father have?

   _____

4. What college major does your mother have?

   _____

5. Which district of Tbilisi do you live in?

   _____

6. Are you or your family considering hiring a tutor to help you prepare for the Unified National Exams?

   ☐ Yes
   ☐ No

7. In this question, ranking is measured by a number from 1 to 100, with 1 indicating the highest rank and 100 indicating the lowest rank.

   On a ranking scale of 1-100, where do you think you would rank in terms of your scores from the Unified National Exams when compared to all individuals applying to university that year?

   _____

8. Imagine you just graduated from your desired major and you were working full time. What do you believe is the average amount in GEL that you would earn per month from full-time hired employment?

   Example: You believe that right after university graduation, you would earn X GEL from hired employment.

   _____

Round 2 (Revised Intended College Major Choices)

Please read each question and respond carefully. Depending on your responses, we will provide you with detailed information on:

- The student admission process at universities for the major
- Chances of being admitted for the major
- Availability of international exchange programs for the major
- Other relevant information

This questionnaire contains three questions. Please respond to all the questions. If any question is unclear, please raise your hand.

1. Are you planning to apply to a university upon graduating from high school?

   ☐ Yes
   ☐ No

The following questions pertain to your college major choice. A detailed description of each major can be found in appendix 1. From the list below, please select/mark your top desired major. Note that based on your major choice, we will provide you with detailed information on the university admission process, the number of applicants and available places, availability of exchange programs, and other relevant information.

2. Have you discussed your future major choice with your parents over the last month?

   ☐ Yes
   ☐ No

3. Please select your top desired major from the list below. Please select only one major.

   ☐ Exact and Natural Sciences
   ☐ Medical Studies
   ☐ Economics and Business Administration
   ☐ Social Sciences
   ☐ Arts and Humanities
   ☐ Law

Round 3 (Actual College Major Choices)

The phone survey script

Hello Mr./Ms. *[Name]*. You participated in our survey on college major choices a year ago (two years ago for Grade 10s). Thank you for your participation. Would you have a few minutes to answer our questions?

1. Have you been admitted to a university?

   ☐ Yes
   ☐ No

2. What major are you going to study at university?

   _____

3. Is your current major choice different from your desired major choice[28]?

   _____

Thank you for your responses, your time is very much appreciated. We wish you good luck with your future studies!

[28] Note that desired college major choices are reported to the National Examination Centre before the exams and admission decision. Desired and current major choices may be different in case of insufficient exam scores.

7.3 Appendix C

Determinants of College Major Choices (Supplementary Analysis)

Do students revise their majors toward majors associated with higher wages? Figure 3 displays the fraction of students who revised their actual major choices toward those associated with higher wages. The vertical bars represent the share of students for whom the real wage differences between the final and baseline specialization choices are positive. If higher wages were the driver for the college major changes, then one would expect that more students in the treatment and spillover groups would revise toward majors associated with higher wages. However, coefficient estimates in Table 6 show the specialization revision patterns across the final and baseline major choices are not explained by higher wages.[29] We also check whether the absolute or percentage differences in actual wages play a role - tables A2 and A3 derive similar results. Next, we investigate the extent to which revisions are driven by differences in employment opportunities by major.

The revisions are not driven by the differences in the wages between the baseline and actual specialization choices. Therefore, changes in the college major choices cannot be explained by the wage differentials.

Do students revise their major choices toward majors associated with lower unemployment rates? Figure 4 displays the fraction of students who revised their actual major choices toward those associated with lower unemployment rates. The vertical bars represent the share of students

[29] The coefficient estimates in column 2 is negative but insignificant at 5% level. Note that we do not find any significant effect of the actual wages on intended choice revisions. Thus, neither intended nor the actual major choice revisions are driven by differences in actual wages.

for whom the real unemployment rate differences between the actual and baseline specialization choices are negative. If employment opportunities were the driver of the revisions in the majors, then more students in the treatment and spillover groups would revise their majors toward those associated with lower unemployment rates. Coefficient estimates in table 6 suggest that more students in the treatment group revise toward majors associated with lower unemployment rate than in the control group, however the effect is insignificant. Do the absolute or percentage differences in unemployment rates explain the revisions? Tables A2 and A3 illustrate that neither percentage nor absolute differences in actual unemployment rates explain the changes in the specialization choices. Next, we investigate the extent to which revisions are driven by the differences in the expected earnings.

The revisions are not driven by the differences in the employment opportunities between the baseline and actual specialization choices. Therefore, changes in the specialization choices cannot be explained by the differences in unemployment rates.

Do students revise their major choices toward majors associated with higher expected earnings? Figure 5 displays the fraction of students who revised their actual major choices toward higher expected earnings. The vertical bars represent the share of students for whom the expected earning differences between the actual and baseline specialization choices are positive. We do not find any evidence of expected earnings explaining the change in the actual college major choices. Coefficient estimates in table 6 derive similar results.[30] Thus, we conclude the expected earning differences between the two majors do not play a role. What are the other determinants, if actual wages and unemployment rates are not decisive for students when making their decisions? We

[30] Tables A2 and A3 show that the results remain the same in the alternative model specifications where the dependent variable is either the actual or percentage difference in the expected earnings.

explore the role of perceived actual wages and unemployment rates as a potential determinant. Next, we investigate the extent to which revisions are driven by the differences between perceived and actual wages.

The revisions are not driven by the differences in the expected earnings between the baseline and actual specialization choices. Therefore, changes in the college major choices cannot be explained by the expected earning differentials.

Do students revise their major choices toward majors associated with higher relative wages? Figure 6 displays the fraction of students who revised their actual major choices toward higher relative wages. Relative wage is defined as the difference between actual and perceived wages associated with the actual and baseline specialization choices, respectively. As an example, consider the students who revised their majors from economics and business (baseline) to exact and natural sciences (actual). Table 3 reports the actual and perceived wages of individuals with a degree in economics and business, 890 GEL and 1,696 GEL, respectively. In contrast, exact and natural sciences diploma holders actually earn 771 GEL, while students perceived that the wage was 940 GEL. Thus, students overestimated the cost of changing the specialization. In fact, one would only give up 119 GEL if choosing *exact and natural sciences* instead of *economics and business*. However, students in our sample perceived that the revision would be associated with a reduction in the wage of 756 GEL, much larger than the actual difference, 119 GEL.

Figure 6 shows the share of students whose revision behavior satisfies the following condition:

$$\Delta W_{Actual} - \Delta W_{Perceived} > 0,$$

where W stands for the average monthly wage and the differences between actual and perceived wages are defined as follows:

$$\Delta W_{Actual} = \frac{W_{Actual}\,(Actual\ Major) - W_{Actual}\,(Baseline\ Intended\ Major)}{W_{Actual}\,(Baseline\ Intended\ Major)}$$

$$\Delta W_{Perceived} = \frac{W_{Perceived}\,(Actual\ Major) - W_{Perceived}\,(Baseline\ Intended\ Major)}{W_{Perceived}\,(Baseline\ Intended\ Major)}$$

The following rationale explains the students' revision behavior - they learned that they did not have to sacrifice as much earnings by changing their specialization, as they perceived. If the differences between the actual and perceived earnings were the driver of the specialization choices, then one would expect that more students in the treatment and spillover groups would revise their majors toward higher relative wages compared to the students in the control group. Coefficient estimates in table 6 suggest that this is not the case. Next, we investigate the extent to which revisions are driven by the differences between the perceived and actual unemployment rates.

The revisions are not driven by the differences between the perceived and actual wages across the baseline and actual major choices. Therefore, changes in the specialization choices cannot be explained by the differences between the perceived and actual wages.

Abstrakt

Studenti mohou mít při rozhodování o vzdělání nepřesné představy o budoucích výdělcích a uplatnění. Tento článek zkoumá vliv informování na zamýšlenou a výslednou volbu studijního oboru v Gruzii. Středoškolští studenti v našem experimentu systematicky nadhodnocují příjmy a nezaměstnanost vysokoškolských absolventů. Zjišťujeme, že o 10 % více studentů, kteří byli informováni o skutečných příjmech a nezaměstnanosti, změnilo svou volbu studijního oboru oproti studentům, kteří informováni nebyli. Změny ve volbě studijního oboru jsou částečně dány rozdílem mezi přibližnou představou o nezaměstnanosti a skutečnou nezaměstnaností. Naproti tomu se zdá, že rozdíly v příjmech nehrají roli. Také odhadujeme a nacházíme vliv na studenty, kteří informaci nezískali přímo. Nepřímý vliv se projevuje pouze u starších studentů, kteří jsou blíže ukončení střední školy. Zjišťujeme, že okamžité změny v zamýšlené volbě oboru nejsou propojeny s konečnou volbou oboru, což naznačuje, že měření vlivu informace na bezprostřední úmysly nemusí být postačující k pochopení, jak informace ovlivní skutečné životní volby. Zjišťujeme, že informování má značný přímý i nepřímý vliv na volbu univerzitního oboru.

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Phone: + 420 224 005 153
Email: office@cerge-ei.cz
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