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ABSTRACT

Does Gender Matter? The Effect of High Performing Peers on Academic Performances*

This paper exploits student-level administrative data on the population of Italian university students from 2006 to 2014 to analyze the effects of high performing (HP) male or female peers on individual academic performance, according to the gender of the student. The identification strategy is based on quasi-random variation in the exposure to HP peers across cohorts, within the same university and the same degree program. The impact of HP students, proxied by their high school final grade, is heterogeneous. We found that female HP peers have stronger positive effects than HP males, in particular with peers of the same gender. Moreover, there is evidence that the exposure to HP males can be even negative, especially for female students in competitive environments, such as the STEM fields, and for low ability students of both genders.

JEL Classification: I22, I23, C21, C35

Keywords: human capital, higher education, university performance, gender, peers

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1. Introduction

This paper estimates the effects of high-achieving peers on individual academic performance, differentiating by the gender of the student and by the gender of the high performing (HP) peers. In particular, we consider HP peers that are enrolled in the same degree program and university during the first academic year and we analyze their effects on several individual outcomes, such as the grades obtained, the number of credits achieved and the probability to drop out.

Theoretically, there are opposite effects that can be generated by the exposure to HP peers. On the one hand, a demanding environment could be performance enhancing: students may benefit directly from higher ability classmates through knowledge spillovers during class or study sessions and, in addition, students may be motivated to work harder to keep up with their HP peers. On the other hand, a HP classroom environment and large gaps in skills between competitors may negatively impact self-perception, because it becomes harder to be ranked highly, and this can have a perverse effect of reducing effort's incentives. These effects of exposure to high performing peers may reasonably vary according to the gender of the students and to the gender of the high performing peers. Males and females are different with respect to psychological attitudes, risk preferences, attitude toward competition and negotiation, being these at the origin of the gender gaps in educational and labour market outcomes (Marianne, 2011; Azmat and Petrongolo, 2014). In fact, women appear to be more risk averse and they generally under-perform in competitive environments (Gneezy et al., 2003; Niederle and Vesterlund, 2007; Eckel and Grossman, 2008; Croson and Gneezy, 2009; Buser et al., 2014), showing a lower degree of self confidence about their own ability (Bordalo et al., 2019).

In this work we concretely ask the following questions: does a greater exposure to high-achieving females or males positively or negatively affect the student's performance? Are female and male students equally affected by the presence of HP peers? Does this effect differ according to the fact that the student has the same or a different gender of their HP peers? We address these questions using student-level administrative data that cover the population of the Italian university students from 2006 to 2014 (Anagrafe Nazionale Studenti). The data follow the student from enrollment to graduation/dropout and provide several information on the academic career of the student and of his/her peers and on their educational background. We focus on the first year's academic performance, considering the number of credits achieved and the average grade obtained at the exams and the probability of dropping out.

There are two methodological problems that are important to take into account in the identification strategy, which refer to selection and to reflection. The selection problem consists in the fact that peer groups are usually formed endogenously and that it is empirically difficult to correctly distinguish peer effects from selection effects. To solve this, we identify the causal effect by exploiting variation in the exposure of students to high performing peers across cohorts within a university and within the same degree program. The basic idea is to compare the outcomes of students from adjacent cohorts who have similar characteristics and face the same university and degree, but they differ in the fact that cohorts have different fractions of HP female and male students (with respect to the total number of peers) due to purely random factors. This strategy is based on the assumption that a student may make decisions based on the overall characteristics of the degree program/university, but that s/he does not decide to enroll on the basis of the specific characteristics of their cohort (in terms of ability and gender) within the same degree program and university. Thus, the variation due to differences across cohorts within the same degree program and university can be treated as quasi-random and allows us to correctly estimate the effect of HP male and female peers on individual performance.

The second methodological issue to deal with regards the reflection problem, that refers to the fact that it is impossible to distinguish the effect of peers on the individual from the effect of the individual on peers because they are simultaneously determined (Manski, 1993). In order to take into consideration the reflection problem, the high performing students are defined according to the final grade obtained in high school; in particular, HP students are those that obtained a grade in the top quintile of the distribution of the grades recorded in the same secondary school and in the same year. It is important to notice that the high school grade, the variable chosen for the classification in HP peers, is determined before individuals meet and interact with their fellow students at university, in order to avoid reflection.

This paper is related to a very recent literature on the gender effects of high performing peers in the school setting (Mouganie and Wang, 2020; Feld and Zölitz, 2018; Cools et al., 2019). The results in these works seem to stress that a higher fraction of HP peers mostly benefits the students of the same gender, while the effects of HP male students on the females can be even negative. These findings are completely in line with the predictions of the the previously mentioned literature that point out the competitiveness of boys and the discouragement of girls in the face of competition. Moreover, HP females may be beneficial for the other female students, because the HP girls may have a role model or an affirmation effect that encourages their female classmates.

Our results confirms that the gender and the ability of university' peers are environmental factors that may influence students' performances. We underline four aspects of our results that are particularly interesting. First, the (positive) effect of female HP students on the other students seems to be stronger than that of HP males. Second, there is a particularly strong and positive effects of high performing female students on the peers of the same gender; a possible explanation, as suggested by the literature, is that HP girls may have a role model for the other female peers. Third, we find negative effects of HP male peers on females, confirming the finding in the literature according to which there may exist, for female students, adverse effects related to the increased competition or pressure of high performing males that negatively affects their performance. This is particularly evident when we consider the students enrolled in STEM degree programs, which are typically considered particularly demanding and where there is a larger gender gap. However, it is important to point out that in these degrees, the negative effects that derive from the exposure to male HP students do exist also for the peer students of the same gender, even if they are smaller. Finally, we find adverse effects coming from the HP male peers also when we consider low ability students of both genders.

Understanding the nature of peer group's effects and the role of gender in education is fundamental for the efficiency of educational processes and the organizational design of school systems, in order to improve student outcomes. These results of asymmetric peer effects may thus suggest a potential role for policy in determining the optimal mix of students within classes that may result in aggregate achievement gains. Moreover, it is important to stress the fact that our study involves students that are young adults. This implies that our findings do not only concern the context of education and class formation, but they can teach us something important about how men and women interact also in the workplace. In this view the paper gives hints also about optimal work team formation and organization.

The rest of the paper is organized as follows. After a review of the literature, the Section 3 presents the data and Section 4 describes the empirical strategy and discusses the identification issues. Section 5 assesses the validity of the identification strategy and the results are set out in Section 6, where we investigate the existence of heterogenoues effects and where we perform some robustness checks. Section 7 concludes.

2. Literature review

This paper contributes to and brings together two strands of the literature of peers' effect that focus on the role of the peers' ability and of the peers' gender in influencing the students' performance.

The relationship between the peers' ability and the student's achievement has been widely studied (Boozer and Cacciola, 2001; Zimmerman, 2003; Hanushek et al., 2003; Henry and Rickman, 2007; Carrell et al., 2009). The majority of the papers found a positive relationship of high ability peers in children, while in the higher education setting the results are more controversial, because of the potential negative effect of competition and pressure on certain types of students, in particular women or low ability students[1]. For example, Fischer (2017) found that, in US universities and in STEM degrees, women who are enrolled in a class with higher ability peers are less likely to graduate because they become discouraged by the competitive environment. Feld and Zölitz (2017), using data from a Dutch business school, reports that while students benefit from better peers on average, low-achieving students are harmed by HP peers, because of the changes in group interaction. On the contrary, in a very recent working paper, Humlum and Jensen (2019), using detailed Danish administrative data covering the entire population of university students, found that high quality peers have beneficial effects for the decision to drop out and that these effects are more

[1] While the effects of good peers is not obvious across the grades, the negative effects of disruptive kids seem to be confirmed in several papers (Carrell et al., 2018; Lavy et al., 2012).

pronounced for low ability students. As regards the Italian setting, De Paola and Scoppa (2010) studied peers' effects of students enrolled at the University of Calabria and find that peer group abilities have considerable and positive effects on students' academic performance.

The second strand of the peer literature that is linked to our work is the one that studied the effects of the peers' gender in the school and in the academic setting. Social interactions between genders in the school setting seem to play an important role in achievement and career choices. A number of studies have shown that girls and boys benefit academically from an increase in the number of female peers in kindergarten (Whitmore, 2005), elementary school (Hoxby, 2000), middle school (Hu, 2015; Lu and Anderson, 2015) and high school (Lavy and Schlosser, 2011). However, this evidence is not unambiguously confirmed, since some other works do not find evidence of substantial peer gender composition effects (Oosterbeek and Van Ewijk, 2014; Anelli and Peri, 2019). In addition, some works (Han and Li, 2009; Black et al., 2013; Fischer, 2017; Hill, 2017; Brenøe and Zölitz, 2020) tested whether the beneficial effects of the female share of the peers differ by gender, with mixed results[2].

In this paper we combine the two, by showing that it is interesting to simultaneously consider the gender and the ability of the peers, as done in some recent papers. For example, Cools et al. (2019) found that a greater exposure to high-achieving boys in high school decreases girls' short and long run outcomes (complete a bachelor's degree, math and science grades, labor force participation), because of the lower self-confidence and risk aversion of the girls with respect to the boys. A greater exposure to high-achieving girls has, on the contrary, some positive effects only on lower ability girls. Also Mouganie and Wang (2020), focusing on high schools' individuals, find that an increase in the proportion of top performing male peers among high school peers has negative effect on girls, while an increase in the proportion of top performing female peers encourages girls to pursue a science track and also improves their college outcomes. As regards the university setting, Feld and Zölitz (2018) found that higher-achieving male peers cause men to study harder, to achieve better grades, and to be more satisfied with the course environment, consistently with research showing that men thrive in more competitive environments. On the contrary, woman's performance and study efforts are not affected by higher-achieving male or female peers. Also Ficano (2012) obtained the same results: male peer academic quality positively and

[2]For example, according to the findings in Hu (2015) and Hill (2017), larger share of females are associated to better outcomes especially for the male students. However, the opposite findings are reported in Lu and Anderson (2015) and in Black et al. (2013). Han and Li (2009) found evidence that females respond to peer influences, whereas males do not. According to the authors, such gender difference is compatible with the social psychology theories that females are more easily influenced, especially by their friends and close peers. Using data on PHD programmes, Bostwick and Weinberg (2018) found that more female-friendly environment increases the female students' persistence in the programme and probability of on-time graduation, showing the importance of increasing diversity on the basis of gender.

significantly influences males, while female peer academic quality has no statistically significant effect on either males or females.

These results point out that high performing males seem to negatively affect females' performance and to positively affect males' performance and these are explained by psychology studies and by the experimental economics evidence that suggest that men are more competitive while women are more reluctant to put themselves in a position where they have to compete against others, because women have lower expectations about their relative ability and they are more averse to risk (Gneezy et al., 2003; Datta Gupta et al., 2005; Niederle and Vesterlund, 2007). The effect of female HP students may be also positive, but only for females. The interpretation of this result refers to the fact that an increased share of HP female peers in quantitative fields may provide a role model for female students, mitigating the adverse effects of negative gender stereotypes and altering females' beliefs. Starting from adolescence girls and boys face increased pressure to adopt culturally sanctioned gender-role identities: same sex parent and other relevant adults in a child's life (i.e., teachers) are important for modeling and reinforcing gender appropriate behavior.

As summarized in the previous paragraphs, the papers that combine the effects of ability and gender are very scarce and the topic reasonably requires a deeper investigation. We are convinced that our analyses may help to improve the knowledge of these phenomena, making contributions to the existing literature in three important ways. First, the availability of data that cover all university students for several years may provide clean and solid estimates, while many mentioned papers only rely on specific universities and years. Second, there are very few papers that look at these kind of interactions in the academic environment. These are particularly interesting since young adults are involved and, consequently, the results obtained may be informative also in other settings, for example at the workplace. Third and more broadly, this paper contributes to a better understanding of the origins of gender differences in educational choices and labor market outcomes. In fact, the gender university peer quality seems to represent an important aspect of the social environment that shapes the individuals' academic outcomes and preferences.

3. Data

We exploited the Anagrafe Nazionale Studenti (ANS), a unique dataset that contains administrative records on students' enrolments, academic career and high school background in all the Italian universities. The main advantage of our analysis is that we can rely on longitudinal data which cover the entire population of university students in Italy and which allow us to track the student after enrolment. We focused on students aged between 18 and 20, enrolled for the first time at an Italian university over the period 2006-2014, and we look at the academic performance in the first year. Using the freshman cohort rather than cohorts in subsequent years has the added advantage of not being subject to biases introduced by student failure and course repetition (Ciccone and Garcia-Fontes, 2015).

Panel A of Table 1 shows the descriptive statistics of the main university outcomes. The sample is made by almost 1,6 millions of Italian students[3]. As regards our main outcomes, the number of credits gained during the first year ranges from 0 to 60[4], with an average of about 31.3: about 29% of first year students gained less than 15 credits, 31% from 15 to 40 and 40% gained more than 40 credits. The average exam grades (that may range from 18 to 31) during the first year is 24.8. We defined dropout students as those enrolled as first year students in the academic year t who did not enroll at any university in the following academic year t+1 (Modena et al., 2020; De Paola and Scoppa, 2010). Average drop out rate is about 10%, with a slightly decreasing trend over the years considered in our analysis.

The HP students are defined on the basis of the final grade obtained in secondary school. In fact, in order to avoid the reflection problem, it is fundamental to choose a student characteristic that is predetermined with respect to the moment in which the students start to interact and in which we measure the individual outcome. Previous works in the literature have proceeded in several ways using, as a measure of HP students, the grades obtained before assignment to sections took place (Feld and Zölitz, 2018) or the scores in the high school entrance exam (Mouganie and Wang (2020)). We use the final grade obtained in secondary school but, due to possible differences in the students' evaluation across regions and types of schools, we do not simply consider the grade in absolute terms, but we consider the students' grade position in the distribution of the grades obtained in the same secondary school and in the same year. In particular, we classify a student as high performing if his/her final grade is above the 80th percentile of the distribution of the grades of his/her secondary school peers, in the same year in which the students took the final exam. In this way, the final grade is considered in relative terms with respect to the grades obtained by his/her peers in secondary school. The operational problem we deal with is that we observe the final grade only for students enrolled in a university program, while the ideal definition of HP students would be based on the full distribution of grades. Our measure may thus be affected by a selection problem that consists in the fact that the students who enroll may be not a representative sample of the population of the secondary school students. Even worse, due to different transition rates from secondary school to tertiary education - especially according to the type of secondary school (*liceo* versus other schools), the region of residence and the type of degree/university - the degree of selection is likely to vary across university programs. However, if the degree of selection in each degree/university is stable over time, the university/degree fixed effect we include in our model (see below) is a good solution to this problem. These fixed effects are fundamental to reduce also another type of endogenous sorting of students that may be related to the different quality of high schools, that may results in different ability of

[3]we dropped the students enrolled at on line universities, that represent the 1,12 per cent of the total sample.

[4]Few students obtained 75 credits, because they passed in the first year some exams that refer to the subsequent year.

the HP students.

These high performing students, on average, constitute the 16.7% of the students enrolled at university and they show a very high secondary school final grade, equal to 97.2 on average (the grade ranges from 60 to 100), with a low standard deviation (3.9). Moreover, as reported in table 2, high performing students obtain a higher average number of credits at the end of the first year with respect to the other students, an higher average exam grade and they are less likely to drop out. It is also important to check the possible differences in the female and male HP peers in term of ability, in order to be sure that the different effects of HP female and male peers is a matter of gender, and not related to quality. The table shows that the differences between HP males and females are negligible. For example, the average high school grade is 97.13 for HP males and 97.20 for HP females (only 0.07 points higher). In order to check if there are any differences between HP male and female in each university, degree and year, we also computed the average values of the school grades for HP male and female peers for each degree/university/year and we then regressed these on the gender and on degree, university and year fixed effects. For school grades, the differences decreases to 0.02 points. This is fundamental in order to be sure that our explanatory variables are actually going to capture the effects of gender, and not also possible differences in the abilities of the two groups.

The estimation of peers' effects depends on the accuracy with which one identifies the set of peers relevant to a specific student (Carrell et al., 2009, 2013). So, we considered for each university, degree and year, the number of male and female peers, leaving out the students itself (Panel B of Table 1). Notice that we do not simply consider the most general definition of degree, but we separately consider each field of specialization, in order to be sure that the reference student and his/her peers attend the same classes and have to pass the same exams. In our opinion, this definition of peer group correctly captures the possible interactions of the students in their study program. The average number of peers is 158, the minimum value is 8 and the maximum value is 487. Of course, depending on the size of the class, the students may have tighter or looser connections. In order to check for this, we display also the results taking into considerations the size of the classes in Section 6.2.

Then we computed the fraction of male and female peers that are high performing, leaving out the students itself, over the total number of peers. On average, the average (across course-university-year) share of high performing female and male peers are respectively equal to 11 and 6%. Figure 1 plots the distribution of the share of high performing female and male peers: a large difference between the two variables is apparent with the share of high performing males more concentrated around zero and the share of females more evenly distributed. The incidence of zero high performing male peers is higher in sanitary and humanities degrees, and lower in social and scientific fields. The sanitary and humanities degree are also characterized by a lower incidence of male students, respectively equal to 33 and 23% (41% and 54% in social and scientific courses).

4. Estimation strategy

The existence of peer effects are notoriously difficult to correctly identify for problems of self selection in certain degree and university, i.e. that similar people sort into the same groups, and the reflection problem, i.e. that the estimates may capture both my effect on my peers and the effect of my peers on me. In this setting the reflection problem is solved using, as measure of high performing peers, a peer characteristic that is pre-determined with respect to the period in which peers interaction takes place. To solve the issue of self-selection and to account for observed and unobserved characteristics of degree programs, university and students that might be correlated with the composition of the peers, we rely on the idiosyncratic cross cohort variation within degree program/university in the proportion of high-performing female and male students. This methodology has been firstly introduced by Hoxby (2000), which was one of the first papers to use as exogenous source of variation the idiosyncratic changes in the gender mix across cohorts within a given elementary school. Subsequently, this methodology has been widely used in the peers' literature (Hanushek et al., 2003; Lavy and Schlosser, 2011; Lavy et al., 2012; Schneeweis and Zweimüller, 2012; Feld and Zölitz, 2017; Anelli and Peri, 2019; Cools et al., 2019; Mouganie and Wang, 2020). In details, the strategy is based on the comparison of the outcomes of students from cohorts enrolled in the same university and degree program that differ in the proportions of HP students who are female/male in their first year due to idiosyncratic variation. The main assumption at the basis of the strategy is the following: while individuals may make decisions based on overall characteristics of a degree program of a specific university, they do not do so based on the specific characteristics (in terms of gender and ability) of their cohort within the degree program and the university. Thus, the variation over time due to differences in cohorts across degree programs/universities can be treated as quasi-random and all other determinants of the students' educational performances are orthogonal to this within university-degree variation in the share of high performing males and females. This strategy is consistent with our dataset, since we have a large number of cross-sectional units (degree program in each university) that are observed for a large number of cohorts (from 2006 to 2014). We estimate the following equation, separately for female and the male students:

$$Y_{idut} = \alpha + \beta_1 FHP_{dut} + \beta_2 MHP_{dut} + \gamma X_{idut} + \delta Fem_{dut} + D_d + U_u + T_t + \epsilon_{idut} \quad (1)$$

where student, degree course, university and year are indexed by i, d, u, t, respectively.

The dependent variable Y_{idut} is the performance of student i enrolled in the degree program d in university u in year t. We consider the following outcomes, measured at the end of the first year: two variables that capture the performance of the students (the total number of credits obtained in the first year and the average grade in the exams) and the probability to drop out. In particular, in order to capture asymmetric effects along the distribution, we consider the probability to obtain a number of credits and a average grade that is in the first quartile of the overall distribution and the probability to obtain credits and grade in the highest quartile of the overall distribution[5]. Notice that the distribution of grades is calculated over the entire sample (and not by degree) and consequently the reference threshold for defining y is not group-specific. This minimize the problem related to the fact that the position in the distribution is not independent form the those of the other students.

β_1 and β_2 are the parameters of interest and capture respectively the effect of the share of HP female and male peers on the student's outcome. We perform regressions separately for males and females (in stead of using interaction terms), in order to allow to all the parameters to vary for these two groups.

We control for a set of student characteristics X_{idut}, that includes: a dummy variable equals to 1 if the student is high performing, a dummy variable equals to 1 if the student is low performing, a dummy variable equal to 1 if the student is foreigner, a dummy variable equal to 1 if the student is enrolled in a university located in a different area from the one of residence, the type of high school diploma, the region of residence of the student and a dummy equals to 1 if the student is resident in a urban area. In addition, we always control for the variable Fem_{dut}, which is the share of females peers, in order to control for the fact that the student's outcomes may be simply influenced by the gender of their peers, as explained in Section 2. Notice that the share of high performing males in the course/university/period presents a negative correlation with the corresponding share of females (-0.57), related to the fact that some degrees, like the STEM ones, are traditionally male-dominated and characterized by the presence of very good male students, due to the difficulty of the covered topics. At the same time, there are female-dominated degree courses (ex: humanities), in which there are few enrolled males who are HP students.

The year fixed-effects (T_t) control for the differences across cohorts whereas the university and the degree fixed-effects (U_u and D_d) control for unobserved differences in average student characteristics across university and degree and for the endogenous sorting of students from high schools to universities.

Finally, one may be concerned that there still remains cohort-varying unobserved factors that are also correlated with the proportion of top performing female and male students within a degree/university. To deal with the possibility that the average characteristics of a degree program or university may be changing over time, and thus that there may also be changes in selection over time, we include in Section 6.2 the results of the regressions where we include the full set of fixed effects: university/degree (DU_{du}), university/year (UT_{uT}) and degree/year (DT_{dt}). Standard errors are clustered at university/degree/year level.

[5]In order to capture mean effects, we also estimated equation 1 with continuous credit and grade variables as outcome variables. Results, available upon request, are in line with our main findings.

5. Validity of the identification strategy

Our ability to exploit this identification strategy firstly relies on there being sufficient residual variation in the main variables. In order to check this, we examine the extent of variation in cohort composition of HP females and males that is left after removing the fixed effects. After removing year, university and degree fixed-effects, the residual standard deviation for female (male) HP peers is about 0.04 (0.03) for both the sample of female and male students, accounting for just above (below) half of the overall variations (Table 3). Also when we include the full set of fixed effects, whose results are shown in Section 6.2, the residual variation is sufficient.

Second, we check the validity of our identification assumption, that consists in the fact that the within-degree/university changes in the share of top-performing female and male students are uncorrelated with observed and unobserved factors that could themselves affect academic outcomes. Table 4 reports the results of simple regressions where the proportion of high performing male (female) students was used as dependent variable and, as explanatory variables, we inserted all the student's individual characteristics. In the regressions we include the complete set of fixed effects. Although the coefficients are statistically different from zero, the estimates are very low in magnitudes. In general, we can assess that by conditioning on university, time and degree fixed effects, we can eliminate almost all observed correlations between the high performing peer composition and students' background characteristics, lending support to the validity of our identification assumption. This is confirmed by the high differences in the adjusted R2 that refer to the regression with and without the fixed effects displayed in Table 4).

6. Results

We begin our core of analysis by assessing the impact of the share of high performing males and females on credits, on the average grades obtained and on the probability to drop out.

The results obtained can be commented according to different dimensions (Table 5). First of all, we wonder if high performing students have positive or negative effects on the other students' outcomes. We find that being exposed to high performing peers of both sex have beneficial effects on male and female students since it is associated to a decrease in the probability to obtain few credits and low grades, an increase in the probability to have higher credits and grades and in a reduction in the probability to drop out. This is in line with other works in the literature that found that, in the academic setting, students benefit from better peers on average (Feld and Zölitz, 2018). However, it is interesting to notice an important difference between the effects that derive from the exposure to female and male HP peers. In fact, the female high performing peers have beneficial effects on all the considered outcomes, that capture both the extensive margin (in terms of drop out and credits) and the intensive margin (in terms of grades) of the students' performances. If, for example, we had found positive effects only for credits, but not for grades, this would have indicated a trade-off in the high quality peers' effects that generate a rise in the number of the passed exams but at the expense of the quality. The male high performing peers, differently for the female peers, do not improve all the peers' outcomes: in particular, as regards the grades we do not report any significant effects (or even negative for the female sample of students, as will be explained in detail in a few lines). Our findings that female high performing peers have stronger positive effects on their peers' outcomes agree with the some findings in the literature according to which females are, in general, more collaborative, prosocial, compromising and cooperative with respect to males (Guarin and Babin, 2021; Molina et al., 2013; Croson and Gneezy, 2009; Solnick, 2001; Eckel and Grossman, 1998).

As regards the magnitude of the coefficients, we find that the effects are not negligible, especially for certain outcomes. For example, an increase of 10 percentage points in the share of high performing female peers (that corresponds to a 1.5 standard deviation) determines a reduction of around 2 percentage points in the probability that the female students obtain a average grade in the exams that is lower than the 25th percentile of the students' grade distribution and a similar rise in the probability to have a average grade in the exams that is greater than the the last percentile of the distribution.

It is difficult to quantitatively compare the magnitude of the coefficients with the other results obtained in the most related paper of the literature because of the different setting and the different definition of the variables [6].

Second, we are interested in understanding if the effects differ according to the fact that the student has the same or a different gender of their HP peers. As regards the female sample of students, we find that the beneficial effects appear to be greater for the peers of the same sex. This finding is obviously linked to the findings in Mouganie and Wang (2020), according to which, women can benefit from high-performing peers, conditional on them being of the same gender. This **may** imply that female students tend to have stronger information and imitation effects from own-gender high performing peers. On the contrary, it is important to underline that high performing males have not significant effects or even negative effects on the grades of the female peers, in line with the literature that stress out the adverse effects of the competition for females (Cools et al., 2019). As regards the male sample (bottom part of Table 5), we find mixed results when assessing who are the most influencing peers, in term of gender. Regarding credits, the coefficients of the male high performing peers are greater with respect to those of the female ones, while for the grades we find an opposite evidence.

[6] For example, Mouganie and Wang (2020), Cools et al. (2019) and Feld and Zölitz (2018) consider as main outcomes the probability to enroll at university in a scientific degrees and also their independent variable is, in some of the papers, different from ours.

6.1. Heterogeneity

In this section we explore if the effects of high performing male and female peers differ according to the degrees' and students' characteristics, inserting interaction terms.

First, we asses whether there exist differences in the peers' effects in STEM fields with respect to the other fields (Table 6). The STEM fields are characterized by higher shares of male students and higher shares of high performing male students, that may generate a stronger competition and pressure with respect to the academic performance. Our results show that there are significant differences in the impact of high performing males in STEM degrees. We find very strong negative effects on grades for the sample of female students, as already emerged in the literature. Moreover, the positive effect on males' grades disappears, meaning that in these degrees also for males the benefits of the exposure to good peers of the same gender are reduced. However, the negative effect on grades goes together with a reduction in the probability to obtain low credits and to drop out, thus suggesting a trade-off between the effect on quantity and quality on students' performance, especially for females.

Second, as in many studies of the literature, we investigate the HP peers' effects on low ability students (Table 7). The findings of the literature differ considerably: certain papers show that low-achieving students are harmed by HP peers, because of the changes in group interaction, while others reports that lower ability students are more affected by higher quality peer exposure, suggesting that ability spillovers could be a potential channel driving these results students (Feld and Zölitz (2017); Cools et al. (2019)). For example, Bertoni et al. (2020) found that the exposure to better peers increases lifetime earnings of disadvantaged students, coming from families with low parental education, but penalizes privileged students from better educated families. Also Booij et al. (2017) found that low ability students are mostly positively affected, while HP students are completely unaffected by changes in the ability composition of their peers. Our definition of low achieving student is secular to our definition of HP one: a low ability student is the one who shows a final grade in the secondary school that is located in the lower 20% of the distribution of the grades of secondary school peers that decided to enroll at university. Looking at the impact of peers on low ability students, it is particularly interesting to focus on the probability to have credits or grades that are lower than the 25th percentiles and on the probability to drop out, in order to understand if high performing peers may help these students to improve their performance. We find that the effects of high performing female peers are even stronger for male low ability students. On the contrary, high performing male peers have stronger negative effects on low ability females and their effects become negative also for the low ability male peers. These first two results clearly indicate that the adverse effects of male high performing peers are especially generated when some categories of students (low ability) or students in certain courses (the most competitive degrees) deal with them.

Third, we differentiate the effects according to the size of the classes. As shown in Table 1 there are large differences in size across courses: in degree programs with a small number of students enrolled, all the students share all of their classes, while in the largest ones the students may interact share only in a subset of the classes. So, in smaller classes, the effects may result to be stronger. The evidence is mixed (see Table 8): as expected, female HP peers have a lower impact on females in large classes, while, surprisingly, for high performing males the effects are even stronger in large classes for some outputs.

6.2. Robustness

In this section we perform some robustness checks related to the specification and to our definition of HP students.

In table 9 we include a different set of fixed effects. Instead of separately have year (T_t), university (U_u) and degree fixed effects (D_d), we insert a degree/university (DU_{du}), university/year (UT_{uT}) and degree/year (DT_{dt}) fixed effects. Controlling for fixed effects related to a specific degree of each university allows us to deal with the possibility that the average characteristics of a degree program or university may be changing over time and thus that there may also be changes in selection over time. Of course, we are aware of the fact that there may be additional confounding variables that are not completely captured even by these stronger fixed effects. An example can be related to the fact that the grades do not come from standardized exams, but they are assigned by individual teachers and they may vary at university/year/degree level. For this reason, the evaluation criteria could be partly endogenous to the composition of the cohort. However, we think that the set of fixed effects included are able to minimize the role of these confounding variables. The results are completely in line with those of the baseline specifications, as regards the significance and the sign of the coefficients. The magnitudes are, in some specifications, slightly smaller than those obtained in the baseline regressions, especially in the sample of male students. In the table we also present the results of the AIC and of the BIC tests for model selections, that can be compared to those obtained in the baseline regressions. In details, these tests balance goodness-of-fit with parsimony: the model with the lowest AIC and BIC should be selected. Comparing tables 9 and 5, we see that the values of the AIC and BIC tests with the specifications that contain the most rich set of controls are in line- only slightly smaller - than those obtained with the baseline specification. For this reason, we decide to keep, as baseline specification, the more parsimonious model.

In table 10 we presents the results obtained when we classify the HP students according to two different definitions. In the top part of the table, we use the same definition used before (the students whose secondary school final grade is greater than the last percentile of the distribution of the grades obtained in the same secondary school and year among those students who decided to enroll at university), but we do not include the student that have a grade lower than 95, that is in general the grade requested to participate in the majority of the public competitions in Italy. This may help to correct for measurement error in the variable related to the fact that a student may be wrongly considered a HP one just because the other best performing peers decide not to enroll to university or because his/her secondary school peers have particularly bad performances. In the bottom part of the table we use a definition of

HP student that is based on a absolute measure of the grade (greater than 97). These new definitions are more restrictive with respect to the baseline one: the share of high performing peers decreases from 16.7% to 11.9 and 12.5%, respectively.

The coefficients obtained in the regressions are completely in line with those obtained in the baseline specification, in terms of signs and of magnitudes.

7. Conclusions

This paper studies how the gender and the ability of the peers affects males' and females' individual academic performance, in terms of drop out probability, grades and credits obtained in the first year of university. A great exposure to HP male or female peers might affect the course atmosphere, because students might be discouraged and perform worse if they meet peers who just seem to "know it all". In the opposite ways, students might directly benefit from working with high performing peers, which in turn may motivate them. We contribute to this literature by showing that gender peer quality—not just quantity—is of considerable interest. Indeed, the effects of HP peers differ significantly depending on the gender of the student. The universal coverage and large sample size allow us to compare effects across various subgroups of interest and to be confident in the external validity of our results, that are robust to a wide variety of controls and alternative specifications.

We find that HP peers are, on average, beneficial to the other students in terms of credits and grades obtained and of drop out probability. Results show that HP female peers have stronger beneficial effects relative to HP males, and that this is particularly when considering the peers of the same gender. However, there are some exceptions, since the effects of high performing males are not always positive. First, females are damaged (in terms of grade and credits) by the exposure to high performing males especially in highly competitive settings, as the STEM fields. Second, we also find that the negative effects of high-achieving boys do exist in the lowest part of the ability distribution and they refer to both genders: both male and female low ability students suffer the competition of HP male peers.

These results have three important implications. First, they suggest that the student quality is an important input in tertiary education and that universities should be able to attract high quality students in order to improve their students' performance. This issue may be particularly relevant in university systems where public and private universities compete with each others in order to attract the best students. Moreover, these results suggest that policy makers and university institutions should do their best to avoid that high-performing students do not choose to quit studying upon finishing high school, as their going to college is a positive externality to other students, especially if they are female.

Understanding whether girls and boys respond differently to the ability and to the gender peer composition may also give some indications to universities to allocate students in classrooms according to the best allocation strategy. In fact, such heterogeneous effects imply that there are opportunities for redistribution of students that may result in aggregate achievement gains. For examples, in large departments with many classes, it could be optimal to allocate the best female high school graduates evenly across classes. Moreover, the results state the importance to encourage more collaboration in some particularly competitive environments (e.g. STEM field), in order to improve the positive effects of peers, through - for examples- the promotion of team work. Finally, since this study involves young adults rather than children, our findings do not only concern the context of education and class formation, but could also provide insights for organizations looking to induce collaboration among workers, giving hints about optimal (work) team formation. In fact, reorganizing peers' group may could translate in efficiency and quality gains also in the aggregate.

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Tables and figures

Table 1: Descriptive statistics at the student level

	Mean	Sd	Min	Max
Panel A				
Nr of credits	31.3	21.8	0	75
Average grade	24.8	2.8	18	31
Drop out	0.102	0.303	0	1
High performing students	0.167	0.373	0	1
Panel B				
Nr of peers	158	112	8	487
Sh female peers	0.579	0.201	0.114	0.932
Sh high performing female peers	0.105	0.069	0	0.382
Sh high performing male peers	0.055	0.063	0	0.328
N	1,562,618			

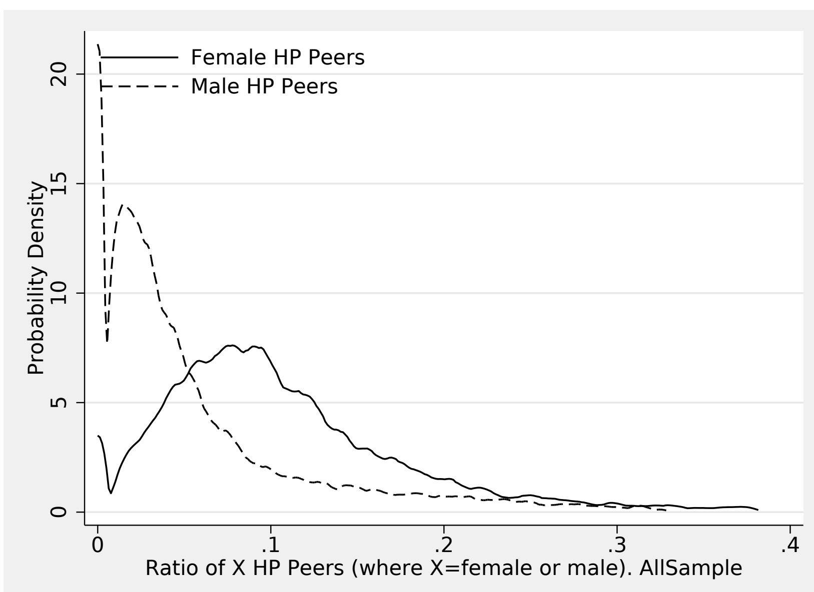
Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. The number of credit gained by the student ranges from 0 to 60 and the average grade exam ranges from 18 to 31. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. High performing students is a dummy variable that take value equal to 1 if the student is classified as high performing. The share of female, high performing female and male peers are computed with respect to those students enrolled in the same degree program, university and year.

Table 2: Descriptive statistics for high performing and non-high performing students.

	Non-high performing		High performing		Difference female-male	
	male	female	male	female	non HP	HP
Nr of credits	27.295	30.757	41.817	41.375	3.462***	-0.441***
					(0.038)	(0.084)
Average grade	24.005	24.782	26.302	26.588	0.776***	0.287***
					(0.005)	(0.011)
Drop out	0.133	0.101	0.041	0.037	-0.032***	-0.004***
					(0.001)	(0.001)
High school grade	74.472	77.482	97.132	97.200	3.010***	0.068***
					(0.018)	(0.016)
N	567,571	734,650	90,974	169,423		

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. The number of credit gained by the student ranges from 0 to 60 and the average grade exam ranges from 18 to 31. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Figure 1: Distribution of the share of high performing peers



Source: our calculations based on ANS data.
Notes: The share of HP peers is calculated with respect to the student's degree/university/year.

Table 3: Variation in Main Variables.

	Female sample		Male sample	
	FHP peers	MHP peers	FHP peers	MHP peers
Raw Variation				
Mean	0.112	0.043	0.097	0.071
Standard deviation	0.069	0.053	0.068	0.072
Net of university; degree; year fixed effects				
Mean	0.000	0.000	0.000	0.000
Standard deviation	0.039	0.025	0.036	0.032
Net of university/degree, university/year and degree/year fixed effects				
Mean	0.000	0.000	0.000	0.000
Standard deviation	0.021	0.014	0.020	0.018

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. This table reports the raw and residual (net of fixed effects) variation in the share of female (male) HP over total number of peers by university/degree/year (respectively FHP and MHP peers).

Table 4: Balancing properties.

	FHP peers		MHP peers	
	Female sample	Male sample	Female sample	Male sample
High performing	0.005***	0.005***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Low performing	-0.003***	-0.003***	-0.001***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
Foreign student	-0.002***	-0.001***	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Out-of-site student	0.000	-0.000	0.000**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
High school liceo	0.001***	0.001***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Living in an urban LLS	0.000	0.000**	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Share of female peers	0.128***	0.155***	-0.121***	-0.134***
	(0.006)	(0.005)	(0.004)	(0.005)
N	893537	652643	898665	647505
Prob > F	0.000	0.000	0.000	0.000
University FE	yes	yes	yes	yes
Degree FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes
Cluster		university/degree/year		
adj. R^2	0.691	0.736	0.787	0.819
adj. R^2 without FE	0.117	0.212	0.324	0.370

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. The share of female and male HP peers (FHP and MHP peers) over the total number of peers for each university/degree/year are the dependent variables and all the variables in rows are explanatory variables. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 5: Effects of high performing peers on student's outcomes. Baseline results

	Female sample				
	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
FHP peers	-0.133***	0.145***	-0.212***	0.198***	-0.091***
	(0.023)	(0.032)	(0.023)	(0.025)	(0.008)
MHP peers	-0.149***	0.073	0.033	-0.072*	-0.042***
	(0.039)	(0.052)	(0.035)	(0.039)	(0.013)
Obs	888800	888800	724899	724899	888800
R-sq	0.096	0.187	0.159	0.201	0.057
AIC	888483.645	836006.674	622224.952	696797.005	246826.331
BIC	888600.621	836123.650	622339.890	696911.943	246943.307
	Male sample				
	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
FHP peers	-0.139***	0.065*	-0.189***	0.110***	-0.098***
	(0.026)	(0.036)	(0.027)	(0.025)	(0.012)
MHP peers	-0.183***	0.143***	-0.049	0.030	-0.083***
	(0.034)	(0.040)	(0.036)	(0.029)	(0.015)
Obs	642127	642127	496096	496096	642127
R-sq	0.108	0.177	0.166	0.211	0.074
AIC	722280.755	509882.457	555630.215	350829.205	339567.581
BIC	722394.480	509996.182	555741.360	350940.350	339681.307
FE	university; degree; year				
Cluster	university/degree/year				

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the situation at the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student is lower than the first quartile or higher than the last quartile of the overall distribution of credits (grade). Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the following controls: dummies for high and low performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. The number of observations is lower in the regressions where the outcomes are the grades, since we don't consider the students that did not pass any exams. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Effects of high performing peers in STEM fields. heterogeneity

	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
			Female sample		
FHP peers	-0.119***	0.116***	-0.223***	0.224***	-0.089***
	(0.026)	(0.042)	(0.027)	(0.032)	(0.010)
× STEM	-0.057	0.096*	0.052	-0.104**	-0.012
	(0.051)	(0.057)	(0.046)	(0.046)	(0.017)
MHP peers	-0.005	0.019	-0.091*	0.065	-0.009
	(0.058)	(0.092)	(0.049)	(0.064)	(0.018)
× STEM	-0.270***	0.096	0.246***	-0.270***	-0.061**
	(0.073)	(0.099)	(0.065)	(0.072)	(0.024)
			Male sample		
FHP peers	-0.138***	0.024	-0.246***	0.136***	-0.102***
	(0.034)	(0.054)	(0.033)	(0.036)	(0.015)
× STEM	-0.019	0.098	0.153***	-0.077*	0.008
	(0.050)	(0.064)	(0.053)	(0.046)	(0.022)
MHP peers	-0.058	0.089	-0.177***	0.145**	-0.081***
	(0.057)	(0.098)	(0.052)	(0.060)	(0.023)
× STEM	-0.177***	0.076	0.189***	-0.168**	-0.003
	(0.066)	(0.102)	(0.067)	(0.066)	(0.028)
FE			university; degree; year		
Cluster			university/degree/year		

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student at the end of the first year is lower than the first quartile or higher than the last quartile of the overall distribution. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the main effects (a dummy for STEM courses) and the following controls: dummies for high and low performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 7: Effects of high performing peers on low performing students. students

	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
			Female sample		
FHP peers	-0.137***	0.172***	-0.199***	0.235***	-0.090***
	(0.024)	(0.033)	(0.022)	(0.026)	(0.008)
× low perf.	0.068**	-0.266***	-0.141***	-0.416***	-0.010
	(0.031)	(0.026)	(0.034)	(0.026)	(0.020)
MHP peers	-0.216***	0.071	-0.007	-0.106***	-0.049***
	(0.040)	(0.053)	(0.035)	(0.040)	(0.013)
× low perf.	0.859***	-0.040	0.584***	0.430***	0.088***
	(0.047)	(0.035)	(0.057)	(0.038)	(0.031)
			Male sample		
FHP peers	-0.128***	0.089**	-0.181***	0.158***	-0.083***
	(0.027)	(0.037)	(0.027)	(0.026)	(0.012)
× low perf.	-0.082***	-0.144***	-0.058*	-0.351***	-0.099***
	(0.030)	(0.024)	(0.033)	(0.024)	(0.021)
MHP peers	-0.282***	0.161***	-0.080**	-0.004	-0.097***
	(0.034)	(0.041)	(0.036)	(0.029)	(0.015)
× low perf.	0.701***	-0.143***	0.273***	0.273***	0.090***
	(0.029)	(0.023)	(0.034)	(0.021)	(0.021)
FE			university; degree; year		
Cluster			university/degree/year		

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student at the end of the first year is lower than the first quartile or higher than the last quartile of the overall distribution. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the main effects (a dummy for low performing students) and the following controls: dummies for high performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. Low performing student is a dummy equals to one if his final high school grade is located in the bottom 20% of the distribution of the grades of his/her secondary school peers that decided to enroll at university. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 8: Effects of high performing peers according to the class size. heterogeneity

	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
			Female sample		
FHP peers	-0.096***	0.113***	-0.204***	0.196***	-0.071***
	(0.023)	(0.032)	(0.022)	(0.026)	(0.009)
× large degrees	-0.057	0.154	0.112*	-0.134**	-0.091***
	(0.064)	(0.106)	(0.063)	(0.061)	(0.021)
MHP peers	-0.113***	0.059	0.068*	-0.104***	-0.030**
	(0.038)	(0.052)	(0.035)	(0.040)	(0.013)
× large degrees	-0.219**	0.055	-0.293***	0.283***	-0.076***
	(0.089)	(0.144)	(0.086)	(0.086)	(0.026)
			Male sample		
FHP peers	-0.122***	0.049	-0.170***	0.106***	-0.077***
	(0.026)	(0.036)	(0.028)	(0.026)	(0.012)
× large degrees	0.064	0.021	0.015	-0.077	-0.108***
	(0.075)	(0.120)	(0.076)	(0.060)	(0.030)
MHP peers	-0.150***	0.127***	-0.010	0.007	-0.073***
	(0.034)	(0.040)	(0.036)	(0.029)	(0.015)
× large degrees	-0.278***	0.113	-0.377***	0.234***	-0.072***
	(0.058)	(0.076)	(0.067)	(0.043)	(0.023)
FE			university; degree; year		
Cluster			university/degree/year		

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student at the end of the first year is lower than the first quartile or higher than the last quartile of the overall distribution. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the main effects (a dummy for large degrees) and the following controls: dummies for high and low performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. Large degree is a dummy equals to one if the number of peers in the university/degree/year is in the top quartile of the overall distribution. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 9: Effects of high performing peers on student's outcomes. Robustness check with different set of fixed effects

	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
	Female sample				
FHP peers	-0.150***	0.080***	-0.181***	0.082***	-0.067***
	(0.025)	(0.028)	(0.024)	(0.025)	(0.012)
MHP peers	-0.049	0.085**	0.008	-0.071*	-0.019
	(0.036)	(0.042)	(0.037)	(0.037)	(0.016)
Obs	888796	888796	724868	724868	888796
R-sq	0.125	0.243	0.190	0.231	0.062
AIC	848809.149	762150.554	584219.368	658637.532	231939.378
BIC	848926.125	762267.531	584334.305	658752.470	232056.354
	Male sample				
	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
FHP peers	-0.083***	0.042*	-0.063**	0.054**	-0.049**
	(0.028)	(0.023)	(0.031)	(0.025)	(0.021)
MHP peers	-0.071**	0.075***	-0.129***	-0.031	-0.015
	(0.031)	(0.026)	(0.035)	(0.028)	(0.023)
Obs	642124	642124	496017	496017	642124
R-sq	0.134	0.228	0.195	0.237	0.080
AIC	692914.850	458209.090	527727.211	324013.205	325635.726
BIC	693028.576	458322.816	527838.355	324124.349	325749.452
FE	university/degree; university/year; degree/year				
Cluster	university/degree/year				

Source: our calculations based on ANS data.

Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student at the end of the first year is lower than the first quartile or higher than the last quartile of the overall distribution. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the following controls: dummies for high and low performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 10: Effects of HP peers on student's outcomes. Robustness check with different measures of high performing peers

	Measure 1: as HP but replace=0 if secondary school grade<=95				
	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
	Female sample				
FHP peers	-0.133***	0.125***	-0.205***	0.166***	-0.101***
	(0.028)	(0.038)	(0.026)	(0.030)	(0.010)
MHP peers	-0.141***	0.126**	0.008	-0.079*	-0.048***
	(0.048)	(0.063)	(0.040)	(0.045)	(0.015)
	Male sample				
FHP peers	-0.136***	0.070*	-0.184***	0.093***	-0.117***
	(0.032)	(0.042)	(0.031)	(0.029)	(0.013)
MHP peers	-0.177***	0.181***	-0.100**	0.043	-0.094***
	(0.041)	(0.048)	(0.044)	(0.033)	(0.016)
	Measure 2: absolute measure (secondary school grade>97)				
	credits<25pct	credits>75pct	grade<25pct	grade>75pct	drop out
	Female sample				
FHP peers	-0.118***	0.176***	-0.183***	0.137***	-0.115***
	(0.031)	(0.038)	(0.024)	(0.028)	(0.009)
MHP peers	-0.027	0.114*	0.040	-0.137***	-0.040***
	(0.044)	(0.062)	(0.038)	(0.045)	(0.014)
	Male sample				
FHP peers	-0.127***	0.117***	-0.147***	0.066**	-0.135***
	(0.039)	(0.043)	(0.030)	(0.028)	(0.012)
MHP peers	-0.088**	0.171***	-0.105**	0.028	-0.113***
	(0.039)	(0.046)	(0.041)	(0.032)	(0.016)
FE	university; degree; year				
Cluster	university/degree/year				

Source: our calculations based on ANS data.
Notes: The working sample includes students aged between 18 and 20, enrolled for the first time at an Italian university in the period 2006-2014. All outcomes refers to the end of the first year. In columns 1-4 the dependent variables are dummies equal to one if the number of credits (average grade) obtained by the student at the end of the first year is lower than the first quartile or higher than the last quartile of the overall distribution. Drop out is a dummy variable equals to one if the student drops out at the end of the first year. FHP peers (MHP peers) are the share of female (male) HP peers over the total number of peers in each university/degree/year. All regressions include the following controls: dummies for high and low performing student, nationality and region of residence of the student, a dummy if the the student is resident in an urban area, a dummy for out-of-site student and the type of high school diploma. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.