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FRIENDSHIP AND STUDY ASSISTANCE TIES OF UNIVERSITY STUDENTS

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We analyze the characteristics of the social networks of students studying in the economics department in one Russian university. We focus on student friendship and study assistance ties and demonstrate how these networks are connected with the individual characteristics of students and their peers. We find that the probability of a tie existing is explained by the gender homophily, and initial student assignment to the same exogenously defined study group. Students ask for help and form friendships with students who have similar academic achievements. Academically successful students are more popular in study assistance networks while there is no gender difference in student popularity in both networks. Our findings enhance the understanding of the role of friendship and study assistance ties in the formation of peer group effects.

JEL Classification: D85, I21, I23

Keywords: student achievement, social networks, peer group effects, higher education

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Social ties within a university environment are an important resource for students. These ties can be useful during and after their study. The influence of the social environment of students on their academic attainments are called *peer group effects*. Most of the authors find positive peer group effects, mainly produced by high achieving students [Lyle, 2009], [Sacerdote, 2001]: the higher the achievements of peers, the higher the achievements of a student.

Some studies however do not find the presence of peer group effects or find rather weak ones [Arcidiacono and Nicholson, 2005], [Brunello et al., 2010], [Parker et al., 2010]. Lomi and colleagues [Lomi et al., 2011] note that controversial opinions on peer group effects presence are caused by the difficulties existing in the empirical calculation of these effects.

Generally, these difficulties are related to the potential endogeneity of the reference group choice. Traditionally, this problem of endogenous choice can be overcome by a sample design which assumes random or exogenous peer group formation. For example, Brunello et al. [2010], Sacerdote [2001], Zimmerman [2003] investigate the influence of peers living in the same room or block in a student dormitory. Lyle [2009], Carrell et al. [2009], Androuschak et al. [2013] analyze the influence of peers studying in the same study group. The whole student cohort or dormitory neighbors might not be the main actors producing peer group effects. We can assume that the closest friends with whom students spend their free time or to whom they ask for help during studies can possibly have a stronger influence on their individual achievements. Peer group effects are not the only influence, it is also the result of a deliberate choice. That is why for the estimation of the influence produced by others on student achievements we also need to study the formation of their social networks.

The process of social network formation and change has been analyzed in detail using samples of students of different races and ethnicities [Goodreau et al., 2009], [Moody, 2001], [Wimmer and Lewis, 2010] or using samples of students characterized by antisocial behavior [Mercken et al., 2009], [Mercken et al., 2012], [Potter et al., 2012]. However, there are few studies on social network structures and academic achievements and peer group effects [Lomi et al., 2011]. Generally, the research is on the influence of student popularity (the proportion of ties directed at a student) or the influence of student activity (the proportion of ties directed from a student) on her achievements; more popular and active students achieve higher results during and after their studies [Babcock, 2008], [Calvy-Armengol et al., 2009], [Conti et al., 2012].

In this study we look at the social structures of student friendship ties and study assistance ties. We define friends as those classmates with whom students spend the most time with. We define study assistants as those classmates students ask for help in their studies. We analyze these particular networks because these types of connections are the inportant ones that

produce peer group effects [Hoxby & Weingarth, 2005]. Additionally, these network types reflect the individual network of each student which could be more important in peer effects than the student group or cohort in general.

We focus on directed friendship and study assistance networks. However, these networks can significantly differ in their structures. We investigate the structural characteristics of the networks and the characteristics of the individuals forming them. Understanding student friendship and study assistance ties allows us to make conclusions about the presence of peer group effects.

Organizational features of undergraduate programs in Russia

Several features of undergraduate educational programs in Russia are important for our analysis. First, students enter university by passing standardized tests. Students with higher scores do not pay tuition fees, while those with relatively low scores pay for their tuition. Study groups are formed prior to beginning of the first academic year by the administration and remain mostly stable during the first three years of study. Lectures are usually delivered to several groups, while seminars and classes are delivered to each group separately. Finally, most of the courses are obligatory and the proportion is elective courses is relatively small. Therefore, students have only a limited possibility to form large and sparse networks with students from other groups, years of admission and programs.

In the university which is the focus of our study there is an open grade system. In all student groups grades are formed according to general and well-known rules and results are publicly available. The final grade for a particular subject consists of the weighted sums of grades for different assignments during the course (participation in discussions, group work, mid-term tests etc.) and from the final exam. There is a 10-point grade system in this university: higher grade indicates higher achievement in a certain subject. As a grade point average (GPA), we use mean value of grades for all exams and tests during the first year of study. At the end of the semester all students are ranked. This ranking is public: students know not only their own place in ranking but also the place of other students from the cohort. The top students in the ranking receive financial support in the form of a monthly stipend (irrespective of family income) and this financial support is a form of motivation for them.

Friendship and study assistance networks

Below we the present hypotheses about the characteristics of friendship and study assistance networks. We consider hypotheses about network structural characteristics (mutuality, transitivity of ties) and about individual characteristics of students (their similarity and popularity effects).

The widespread network effects observed mostly in friendship networks are ties with reciprocity and transitivity effects. According to the first pattern, most of the social ties are mutual [McPherson et al., 2001]. According to the second, most social connections are formed in traids, in other words, two people that have one common friend have a high probability of being connected with each other [Rapoport, 1957]. One of the first studies that paid specific attention to these structures is the work by Goodreau et al. [2009]. They use AddHealth data and analyze dyadic and triadic structures in the connections of high-school students, showing their important role in friendship ties formation.

We assume that in our sample study assistance ties are mostly instrumental ones and do not always imply any intimacy leading to the mutuality and density of connections. That is why we hypothesize that reciprocity and transitivity of ties in study assistance network are lower than in the friendship network.

H1. Friendship ties are characterized by higher levels of mutuality and transitivity than study assistance ties.

Students in our sample are administratively divided into study groups before their first year (without regard to their own preferences and abilities). Classes are organized for each group separately and students very rarely have one class for the whole cohort. Therefore, we hypothesize that students interact mostly with their study group peers. We also include in our model the gender differentiation of ties and assume that ties are more likely to exist between same gender students.

These hypotheses are supported by research showing the importance of homophily in student networks. For example, Mayer and Puller [2007] study online social networks of the US students from several universities. They find strong propinquity in institutional factors (living in the same dormitory or study in the same major). Goodreau et al. [2009] also demonstrate the effects of homophily in gender and student group for friendship tie formation.

H2. In both friendship and study assistance networks there is a similarity of students in their study group and in their gender.

Similar academic abilities, measured by tuition type and GPA, predict friendship connections between students. However, we believe that this effect is weaker for study assistance networks because individual similarity is more important for friendship ties and less important for instrumental ties that are possibly characterized by dissimilarity.

In addition to the study of the institutional similarity in tie formation, Mayer and Puller [2007] also study the similarity in academic achievements. They find that students with similar grades are more likely to be connected. However, this similarity is not as significant as the similarity in race or institutional factors. Lomi et al. [2011] also show that students, their friends and assistants are characterized by similar academic achievements.

H3. In friendship network there are homophily effects between students in their academic achievements and type of tuition whereas there are no such effects in study assistance networks.

Finally, we hypothesize that bright students are more popular in study assistance networks. At the same time, their role as leaders in friendship networks might be less important because the friendship popularity might not be directly connected with the academic success. Additionally, in our sample female students get higher grades. Therefore, female students might be more popular in study assistance networks compared to male students.

Calvo-Armengol et al. [2009] investigate the AddHealth data and find that if a student plays a key role in a network he or she gets higher grades. Babcock [2008] and Conti et al. [2012] study the long-terms effects of popularity and activity in secondary school and show that more socially successful students are more likely to enter college or have higher salaries in future.

H4. Academically successful students and female students are more popular in study assistance networks.

While a friendship network is more private and study assistance network is more instrumental, both of them are strongly connected with each other. Students are likely to ask their friends for help regardless of their abilities. We predict a similar situation for study assistants of these students – they will also be friends. For example, Lomi et al. [2011] estimate how peer

group effects are transmitted during the year through friendship and study assistance ties. They use data on students from an Italian university and show that these networks are highly correlated.

H5. Students, connected in a friendship network, are more likely to also be connected in a study assistance network and vice versa, connections in study assistance networks would also define friendship networks.

Data and Methods

We use data from a questionnaire survey of undergraduate students in their second year in the Economics department at the Higher School of Economics (Nizhny Novgorod, Russia) in the 2010-2011 academic year. There are data on 94 students from 7 study groups (overall there are 134 students in this cohort). Overall we analyze about 70% of the whole network, which is an acceptable level for empirical network studies [Kossinets, 2006; Robins et al., 2004].

Descriptive statistics on student characteristics are presented in Table 1 (standard deviations are in parentheses).

Table 1. Descriptive statistics of student characteristics

	Mean (SD)	Min	Max	No of obs.
GPA	6.89 (.93)	4.70	9.52	94
Number of ties in friendship network	3.49 (1.31)	0	5	94
Number of ties in assistance network	3.35 (1.47)	0	5	94
Proportion of men	.37 (.49)	0	1	94
Proportion of tuition free students	.68 (.47)	0	1	94

We study two types of student social connections: friendship and study assistance ties. In the questionnaire we asked about these connections in the following way:

1. Please indicate up to 5 of your classmates with whom you spend most of your time.

2. Please indicate up to 5 of your classmates whom you ask for some help in your studies.

Generally, students indicate less than 10 of their classmates with whom they have certain type of connection.

Table 2. Frequencies of ties in friendship and study assistance networks

Number of ties	Friendship network	Study assistance network
	Frequencies	Frequencies
0	4	7
1	6	5
2	7	10
3	19	21
4	39	28
5	19	23

Both of the networks are directed networks. Table 3 shows the main network characteristics standardized from 0 to 1. Density measures the proportion of observed ties in a network relative to the overall number of ties in this network. We measure edgewise reciprocity which shows the proportion of edges which are reciprocated. Transitivity indicates a triadic connectedness of the nodes in structures such as $i \dashrightarrow j \dashrightarrow k \Rightarrow i \dashrightarrow k$.

There is no significant difference between networks in their density and transitivity measures. However, the friendship network has a higher proportion of mutual edges. The matrices of friendship and study assistance ties are significantly correlated ($r = 0.56$, $p < 0.05$).

Table 3. Descriptive statistics of network measures

Measure	Friendship network	Study assistance network
Density	.038	.036
Reciprocity	.555	.401
Transitivity	.357	.351

To analyze friendship and study assistance networks, we use exponential random graph modeling or *p** modeling [Frank and Strauss, 1986], [Robins et al., 2007a], [Robins et al., 2007b], [Wasserman and Pattison, 1996]. Social networks show dependencies between ties that lead to matrix autocorrelation. Therefore, we model these dependencies as a social network using the *p** family of models. This method is used for the calculation of the tie structure of the observed network, fixing network structural parameters such as density, transitivity, and fixing the attributes of the nodes. Comparing the observed network with random networks of the same size, we show which structural attributes of the network and which characteristics of the nodes formed the observed network structure. Models were estimated in “statnet” package of R project [R Development Core Team, 2007].

The coefficients of the models are interpreted as logit-coefficients where the dependent variable is the log odds of a tie presence. If the coefficient of a network characteristic is positive, it means that this attribute is more likely to appear in the observed network than could be expected by chance. If the coefficient of a network characteristic is negative, such kind of network microstructures appear more rarely in the observed network than in the random networks of the same size. The model is fitted by Markov Chain Monte Carlo Maximum Likelihood Estimation. The relative quality of the models is measured by Akaike information criterion (AIC) and Bayesian information criterion (BIC).

Table 4. Network attributes used in the models

Attribute	Explanation
Edges	Tendency to form ties
Reciprocity	Tendency to form mutual ties
GWESP (geometrically weighted edge-wise shared partners)	Tendency of connected dyads to have several shared partners
GWDSP (geometrically weighted dyad-wise shared partners)	Tendency of non-connected dyads to have several shared partners

In Table 4 we describe the network attributes used in the analysis. As network characteristics we fix the proportion of edges, reciprocity and transitivity attributes. We measure transitivity with GWESP (geometrically weighted edge-wise shared partner) and GWDSP (geometrically weighted dyad-wise shared partners) and fix them at 0.2. These attributes show the probability that any connected or non-connected dyad in the network has several shared partners [Hunter and Handcock, 2006], [Hunter, 2007], [Snijders et al., 2006]. The edges parameter is comparable with the constant in traditional statistical models.

Results

In tables 5 and 6 we present the results of model calculations. In Model 1 we fix basic network characteristics, in Models 2 and 3 we add homophily in gender, group, tuition, and GPA. In Model 4 we fix popularity effects for gender and GPA. In Models 5 and 6 we use significant variables from previous models with the other type of network as a covariate.

Table 5. Explanation of the presence of a friendship tie by the characteristics of students (std. dev. in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
Network effects						
Edges	-2.089*** (.264)	-3.366*** (.271)	-1.940*** (.273)	-3.450*** (.600)	-4.728*** (.659)	.593 (.829)
Reciprocity	4.192*** (.219)	3.874*** (.224)	4.191*** (.223)	4.275*** (.226)	3.820*** (.230)	3.426*** (.247)
GWESP	2.347*** (.110)	2.030*** (.112)	2.318*** (.110)	2.330*** (.111)	1.992*** (.112)	1.692*** (.115)
GWDSP	-.558*** (.040)	-.479*** (.041)	-0.563*** (.040)	-.556*** (.041)	-.467*** (.042)	-.422*** (.046)
Presence of a tie in the study assistance network						5.250*** (.202)
General homophily effects						
Both study at the same group		1.575*** (.094)			1.586*** (.095)	1.207*** (.121)
Both are female		.843*** (.102)			.714*** (.104)	.816*** (.156)
Both are male		.695*** (.105)			.910*** (.112)	.886*** (.168)
Homophily in abilities						
Absolute difference in GPA			-.397*** (.059)		-.378*** (.066)	-.191* (.086)
Both are tuition free students			.527*** (.105)		.422*** (.115)	.242** (.157)
Both are full tuition students			.308* (.123)		.573*** (.131)	.619 (.199)
Popularity effects						
Popularity of students with high GPA				.197** (.067)	.207** (.079)	-.695*** (.109)
Popularity of male students				-.096 (.117)		
AIC	1834	2174	1884	1836	2224	2945
BIC	1806	2124	1834	1793	2146	2860

*** p < 0.001, ** p < 0.01, * p < 0.05

Table 6. Explanation of the presence of a study assistance tie by the characteristics of students (std. dev. in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
Network effects						
Edges	-2.594*** (.229)	-3.547*** .240	-2.497*** (.239)	-8.483*** (.653)	-10.605*** (.807)	-15.975*** (1.141)
Reciprocity	2.366*** (.233)	2.053 *** (.223)	2.576*** (.225)	3.847*** (.290)	3.237*** (.269)	1.512*** (.282)
GWESP	2.887*** (.114)	2.497*** (.116)	2.798*** (.112)	2.536*** (.106)	2.009*** (.119)	1.647*** (.116)
GWDSP	-.482*** (.036)	-.458*** (.037)	-.539*** (.036)	-.438*** (.028)	-.441*** (.037)	-.341*** (.036)
Presence of a tie in the study assistance network						5.218*** (.206)
General homophily effects						
Both study at the same group		1.679*** (.100)			1.722*** (.113)	1.551*** (.149)
Both are female		.832*** (.099)			.673*** (.111)	.077 (.164)
Both are male		.435*** (.117)			.922*** (.134)	.420* (.194)
Homophily in abilities						
Absolute difference in GPA			-.181** (.066)		-.421*** (.089)	-.421*** (.116)
Both are tuition free students			.957*** (.115)		.428*** (.121)	.496*** (.185)
Both are full tuition students			-.203 (.192)		.617** (.217)	.259 (.296)
Popularity effects						
Popularity of students with high GPA				.779*** (.076)	1.003*** (.103)	1.639*** (.147)
Popularity of male students				-.039 (.106)		
AIC	1644	1977	1717	1807	2179	2957
BIC	1616	1927	1668	1765	2101	2872

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Both networks are more reciprocal compared to random networks of the same size. However, friendship ties tend to be more mutual than study assistance ties. There is no difference between the two networks in the proportion of triad structures. GWESP is positive in both networks. It means that observed networks are highly clustered: connected dyads have several nodes between them. GWDSP is negative, in other words, in our networks we are less likely to observe non-connected dyads with common nodes than in random networks. Reciprocity and

transitivity of ties are important for the interpretation of how peer effects are transmitted. We can assume that the strongest effect on the achievements of a certain student is produced by his or her mutual friends as well as by their closeness in triadic terms.

Both types of connections are more likely to be formed between students that study in the same group. Homophily in gender is also significant for all types of connections. These results are predictable because students spend most of their time in university with their classmates from group and most social ties are gender based.

The same type of tuition is significant for all students in a friendship network and for tuition-free students in a study assistance network. In this case, we observe the differentiation of students in their tuition type that is at the same time an indicator of student abilities and their financial status. We can suppose that students having different tuition types form their ties in a different manner because of their different statuses. The smaller the difference between students in their GPA, the higher the probability that there is a connection between them. We can assume that for each small connected student group (formed according to their abilities) there is a certain student or a group of leaders that strongly affects the achievements of their peers. We should pay specific attention to these groups and to the role of these leaders in peer group effects.

Students with a higher GPA are more popular in study assistance networks whereas in friendship networks the popularity of these students is not stable in different models. There is no difference in the popularity of male or female students. The results suggest that popularity and academic achievements might be connected by inverse dependence. What the mechanisms that make students popular in friendship or assistance networks are; whether these students transfer peer group effects, and what their role in this process is, are questions that need further investigation.

Friendship and study assistance networks are mutually connected: students tied in one type of network are likely to be connected in the other type of network. From the perspective of peer group studies, students that are friends and assistants at the same time arouse specific interest. We can assume that the influence of these peers is stronger than the influence of peers that are solely friends of assistants. At the same time, students form ties in a different way: some of them can ask one group of students for help and be friends with others, some of them can choose the same students as their friends and assistants. In this case, it is not clear whether peer group effects would affect these groups of students differently.

Limitations of the study

This study has several limitations. First, we analyze a small sample of students from a specific educational environment. In comparison with most of the US and European universities, students in our sample have a prescribed educational curriculum. They do not have a wide range of courses to choose from and they cannot construct their own educational program. Most of their time at the university they spend with the same group of classmates. Therefore, it can be argued that our results mostly describe “small world” networks when all the participants know each other.

Second, the Higher School of Economics has an open grading system: all students know the grades of each other. This could mean some students form their friendship or study assistance ties in a way that helps them to increase their achievements. Compared to educational systems where the information about the GPA is private, knowledge about peer grades might affect our results. Thus, our findings describe student network formation only for educational systems with an open grading system.

Conclusions

We analyze friendship and study assistance ties in a university environment. Using methods of network modeling, we find differences between these two types of connections in their structural properties as well as in the characteristics of their nodes.

We find that these networks are overlapping: students ask for study assistance from the same students they are friends with. Their connections are explained by their homophily in gender and study group. Academically successful students are popular in study assistance networks.

Understanding these properties helps us to make hypotheses about peer group effects that can be transmitted through study assistance and friendship networks. First, we see that students more often ask their more academically successful classmates for help. We can assume that regardless of their popularity in friendship networks, they help their classmates with study problems. We pay special attention to these students because they are the main actors that transmit peer effects. Second, we see segregation by student abilities in study assistance network. In our case this influence is slightly significant but it is necessary to check whether this result is stable in other samples. In this case, for each group of friends there is a particular academically successful student that has the strongest influence on the attainment of his or her peers. We study

these small groups better, paying special attention to the triad structures of students where information can circulate. Finally, our results show that academically successful students are popular solely in study assistance networks and not in friendship networks. Whether these students can transfer peer group effects outside their assistance networks and what is their role in this process, are questions that need further investigation.

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