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Friends don't let friends drop out

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ABSTRACT

We combine administrative data from a regional public university with a novel revealed-preference indicator of student friendships to show that socially connected first-year university students are more likely to be retained into their second year. The impact of friends on retention is statistically and economically significant: each friend raises the probability of retention by about 0.6 percentage points, an effect size roughly equivalent to 66 SAT points. This effect occurs in the presence of a robust set of explanatory variables, including unique indicators of a student's prior commitment to the university, and applies to wide variety of student subgroups.

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1. Introduction

Nearly 40% of all undergraduates starting a degree at a four-year university in the United States fail to complete it within six years, with approximately half of these dropouts occurring before the start of their second academic year (NCES 2022a). The US is not unusual in this regard: across 23 OECD countries, the average university completion rate three years after the typical duration of study is only 68%.[1] Given that the college wage premium has been increasing in recent decades, failing to graduate has significant economic consequences (Balart 2016). Exacerbating this issue is that post-secondary returns to education are largely dependent on the completion of a degree, a phenomenon referred to as the 'sheepskin effect.'[2] Schools have addressed this issue in several ways, which commonly includes creating first-year learning communities to help students better engage with course content and intervening with students who struggle early on. The efficacy of such efforts has been mixed (Azzam, Bates, and Fairris 2022; Bowman et al. 2019a). Recent work has highlighted the importance of social relationships, or friendships, in explaining academic success in college but this literature remains nascent and largely reliant on survey data to construct social networks (Martin, Wright, and Krieg 2020).

In this paper, we combine a revealed-preference indicator of student friendships with administrative data on student characteristics, socioeconomic information, and academic outcomes to show that socially connected first-year students are more likely to be retained into their second year. Friendships are revealed using dining hall data from a medium-sized regional public university in the United States. Following the framework set forth in Martin, Wright, and Krieg (2020), we assume that two students are friends if they regularly dine together. This revealed-preference identifier of friends circumvents numerous problems associated with nominated friendships in a survey setting.[3] Since most first-year students frequently use university dining halls, this technique allows us to construct a dining-based social network for the vast majority of first-year students.

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Our primary results reveal an effect of friends on retention that is both statistically and economically significant: each friend raises the probability of retention by about 0.6 percentage points, an effect size roughly equivalent to 66 points on the SAT exam. We further investigate the timing of friendship formation and show that friends present in the last term of the academic year are most salient for explaining second-year retention, suggesting that friends made more recently are more important than those made (and perhaps lost) earlier. Importantly, we find that friends increase retention across all types of students in our subgroup analyses based on gender, first-generation status, high school GPA, residency, and federal Pell Grant eligibility.

Despite the ability to control for a rich set of administrative data collected pre-matriculation, there are two important threats to interpreting any observed correlations between friendships and retention as causal that we address in our analysis. First is the issue of simultaneity, or the possibility that actual or anticipated attrition affects social networks. For example, a student who drops out in the middle of the academic quarter no longer consumes meals on campus.[4] Given our construction of social networks, this person would have no measured friends after leaving the university. Likewise, a new student with plans to transfer to another school prior to their second year may put less effort into making friends during their time on campus. To address early departures, we show our main results hold in fall and winter quarters for students who continue to enroll in the subsequent quarter. We further show the results are robust to a subsample of fall students who indicate they are very unlikely to leave school in a pre-matriculation survey, mitigating concerns that planned departures are driving the findings.

The second issue confounding a causal interpretation of the results is that of omitted variable bias, or an unobserved factor that affects both retention and friendships. For example, poor academic performance or difficulty adapting to the college environment may lead a student to both drop out and reduce socializing behavior. We therefore control for a student's total entries into a dining hall, their first-year GPA, and attempted credit hours. Shocks affecting enrollment and friendships will be captured by these controls, assuming they will also affect dining and academic performance. Another possibility is that students who make more friends are fundamentally different than those who make fewer friends, perhaps because they are more outgoing or affable, and this difference may not be captured by our control variables.[5] We address the possibility of unobserved time-invariant student characteristics in two ways: first by separating friendships made in fall, winter, and spring quarters and second by splitting the sample into those with few versus many fall friends. Each of these methods attempts to control for tastes for friends during an early period (fall) to estimate the effect of friends in a later period (spring).

This research adds to a large body of literature suggests that peer groups are important for explaining academic outcomes in college.[6] For example, Johnes and McNabb (2004) find that a mismatch in the academic qualifications of a student relative to peers reduces the probability of degree completion across universities in the United Kingdom. Many studies leverage random assignment of students to dormitories or classrooms to identify peer effects. However, these studies do not capture a comprehensive measure of students' peer interactions. Specifically, they fail to identify what is thought to be a particularly influential peer group: friends. Friendship network size and friends' characteristics in middle and high school have been shown to impact academic performance (Fletcher, Ross, and Zhang 2020; Hill 2015; Lam 2012; Lavy and Sand 2019) and educational attainment (Mora and Oreopoulos 2011; Patacchini, Rainone, and Zenou 2017). Much less is known about the impact of friends at the post-secondary level, where students are likely to make important decisions about social groups and human capital investments.

Many studies have investigated the predictors of college retention and recent work has highlighted the importance of friends and other social indicators. This work typically finds a positive relationship between campus social relationships and retention, but central to these studies is how friendships are measured, with most relying on student survey data (e.g. Bowman et al. 2019b; Bronkema and Bowman 2019; Sun, Hagedorn, and Zhang 2016) or social media metrics such as on-campus Facebook friends (e.g. Gray et al. 2013; Morris et al. 2009).[7] An important

limitation of using surveys or social media to measure friendships is that friendship nomination is essentially costless in these settings and reveals little about the nature of the social interaction between students.

Our approach utilizes a dynamic, revealed-preference identifier of friendships to demonstrate the relative importance of social connections in explaining college retention while carefully addressing alternative explanations. This revealed-preference methodology requires students to coordinate and thus entails some cost, providing insight into students' social activities that cannot be gleaned from survey or social media data alone. Our work contributes not only to the peer and friend effect literature, but also the recent work on the importance of non-academic predictors for college persistence (Caviglia-Harris and Maier 2020).

In the study most similar to our own, Bowman et al. (2019a) use first-semester freshmen dining data to construct an index to capture the number and frequency of different students with whom a student dines at large research university.[8] The authors show this index is predictive of year-to-year retention and graduation up to nine years after enrollment. Limited to first semester data, this study is unable to show how social relationships across academic terms differentially predict retention nor do the authors break down their results by student characteristics to test how students who are historically more likely to drop out are impacted by friends.[9] Further, this study uses only one semester of dining data whereas in the present study we are able to use six full years of dining data which yields more than four times the number of student observations in the analytical sample. This is important because the authors conclude that early-college measures of socialness are predictive of retention, whereas we show that conditional on friendships made later in the academic year, early measures of sociability are not predictive of retention.

2. Data

2.1 Description of the university and retention outcomes

We use administrative data from Western Washington University (WWU), a regional, comprehensive university located in Bellingham, Washington USA, with a fall undergraduate enrollment of approximately 15,000 students and a graduate population of around 1,000. WWU is annually ranked among the top five regional, public, comprehensive masters-granting universities in the U.S. News and World Report rankings.

WWU operates a three-quarter academic year with a fourth, optional summer quarter that enrolls about one-fifth of the usual number of students. Because summer quarter students live off-campus and do not have a dining plan, we focus our analysis on the traditional fall, winter, and spring quarters of the academic year. These three quarters are each 11 weeks long which includes a final week dedicated to exams. Students typically attend classes in all three quarters. Since the 2013–2014 academic year, 98% of first-time undergraduates enter the university in the fall, and fewer than 1% who do not attend classes in either winter or spring return to the university later.

Our research focuses on student retention between the first and second year on campus as this is when nearly half of all dropouts occur (NCES 2022a).[10] Our analytical sample consists of first-time undergraduate students defined by the Integrated Postsecondary Education Data System (IPEDS) as traditional freshmen and students who, prior to high school graduation, attended a dual enrollment program between their high school and a local two-year community college.[11] Our dining data begins in the Fall of 2013 and continues through the Fall of 2019. However, because the Covid pandemic disrupted many students' retention decisions prior to the end of the 2019–2020 academic year, we end our analysis with the first-time student cohort of Fall 2018 who were either retained or not retained into their second year of college prior to the pandemic. Over the resulting six-year period, the number of first-time incoming cohorts of students ranged from 2,795 (in Fall 2013) to 3,147 (in Fall 2018) and totaled 17,177 students across all six academic years.

Using unique student identification numbers (IDs), we merge data from the university dining halls with administrative records to observe each student's background prior to enrolling in WWU as well as students' academic records after enrolling. Table 1 presents descriptive statistics of the administrative data, with variables grouped into several categories: dining, academic, demographic, socioeconomic, and measures of a student's attachment to the university. Among the academic variables is our primary dependent variable: *Retain* which is equal to 1 if a student returns to WWU during the fall quarter of their second year and 0 otherwise. Table 1 shows that 81.4% of first-year students are retained into their second year at WWU, a number slightly higher than the US average for four-year universities of 76.3% (NSCRC 2022). Unreported in Table 1 is that a small number of students leave the university before the end of their first year. Specifically, five percent of students leave between the fall and winter quarters of their first year and an additional four percent leave between winter and spring quarters. A very small number of these students enroll the following fall so are counted as retained even though they did not have continuous enrollment during their first year on campus.

Table 1 shows that the average first-year WWU student has a score on the SAT exam of 1173 and a high school grade point average (GPA) of 3.41. It is important to note that 3.1% of students were admitted without providing an SAT score and about one percent of students were admitted without providing a high school GPA. In later empirical models, we assign a zero if these measures

Table 1. Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
Dining				
Total dining entries	237.96	148.36	0	866
Academic				
Retain	0.814	0.388	0	1
SAT	1173.51	265.45	0	1600
SAT missing	0.031	0.173	0	1
High school GPA	3.410	0.491	0	4
High school GPA missing	0.010	0.101	0	1
Demographic				
Male	0.415	0.493	0	1
Age (months)	223.392	6.41	188	378
White	0.705	0.456	0	1
Black	0.038	0.191	0	1
Hispanic	0.084	0.277	0	1
Asian	0.129	0.335	0	1
Native American	0.027	0.163	0	1
Ethnicity unknown	0.017	0.129	0	1
Socioeconomic				
First generation student	0.316	0.465	0	1
Dual credit student in high school	0.237	0.425	0	1
Pell eligible	0.249	0.432	0	1
Expected family contribution	24,480	44,164	0	999,999
Non-applicant for financial aid	0.254	0.435	0	1
Attachment				
Log distance from home	5.305	1.073	−7.326	8.718
Fall quarter hours registered	14.48	1.470	2	25
Undecided field of study	0.039	0.170	0	1
WA residency, fall quarter	0.862	0.345	0	1
Survey results: Likelihood of leaving				
Very unlikely	0.356	0.478	0	1
Somewhat unlikely	0.179	0.383	0	1
Uncertain	0.161	0.368	0	1
Somewhat likely	0.039	0.194	0	1
Very likely	0.010	0.100	0	1
Survey missing	0.253	0.434	0	1
Number of Observations	17,177			

Notes: The sample includes all first-time freshmen in the six academic years starting in 2013–2014 and ending in 2018–2019.

are missing and create binary variables indicating each missing variable. We also explore models where we restrict the sample to only students who have no missing observations. In our sample, roughly 42% of students are male, 86% are from the State of Washington, and nearly one-third are first-generation college students. The majority of students are white, about one-eighth are Asian, and 8.4% are Hispanic. About one-quarter of first-year students do not apply for federal financial aid.[12] Among those who do, the average expected family contribution (EFC) to the cost of college attendance is $24,480. However, the average is highly skewed due to some students with very high EFCs. The median student has an EFC of just under $14,000 and ten percent of students have an EFC of zero. For each cohort of first-year students, we compute the EFC quintile and turn these into five binary variables representing the first through fifth quintiles. We also create an additional binary variable indicating if the student does not have an EFC – in essence a binary variable indicating the student did not submit a FAFSA – and later employ the resulting six binary variables in our models. Approximately one-quarter of students qualify for the federal Pell grant.[13]

We also observe some less familiar yet informative data about WWU students. The first comes from a pre-matriculation survey of students that asks, 'How likely is it that you will transfer from WWU to another college or university before you graduate?' There are five Likert-style responses to this question: very likely, somewhat likely, uncertain, somewhat unlikely, and very unlikely. Across the cohorts in this study, 74.7% of students responded to this question and among the respondents, 4.9% claimed they were either somewhat or very likely to leave prior to graduation. Like the case with EFC, we create six binary variables (one for each response and one indicating the survey question was unanswered) and employ them in our retention models. In a sensitivity test, we restrict the sample to only those students who answered this question as indicating they were very unlikely to leave. This accounts for the possibility that students who arrive at the university intending to transfer to another school put less effort into forming friendships.

The second nontraditional variable we use in the analysis is the student's distance from home, measured as the distance between WWU and the centroid of the student's home postal (zip) code at the time of application. We include distance to control for differences in the cost of attending the university or feelings of 'homesickness' that may affect both social interactions and retention. This average distance is 393 miles but again is skewed by the small number of students that come from out-of-state or out-of-country. The median distance is 166 miles and about 12% of students live within 100 miles of the university. To account for the skew in distance, we use the natural log of distance in our estimation models.

Finally, Table 1 shows that the average student registers for almost 14.5 credit hours during the fall quarter of their first year. A student with no prior college credits hoping to graduate in four years must average 15 credits per quarter. Table 1 also reports that at the time of applying, four percent report that they are undecided on what they hope to study. We utilize these variables to help control for students' attachment to the university which likely affects both friendship formation and retention into the second year of study.

2.2 Description of friendship measures

In this section, we describe how friendships are measured from dining data. Students may enter one of three university dining halls only after an employee swipes their ID card through a card reader. The card reader records the student's ID, the location, and the date and time (measured to the second) of each swipe. All WWU students have access to the dining hall, and all students who live in a university residence hall without an attached kitchen are required to have a meal plan.[14] 89.9% of first-year students live on campus and 90% of all students are observed eating in the dining halls at least once during their first year on campus. As Table 1 reports, the average first-year student enters the dining hall almost 240 times over the course of the three-quarter academic year – or about 80 meals per quarter. Since a quarter is 11 weeks long, the average first-year student dines on

campus daily. There is, however, a large variance in the number of meals in a dining hall, as we discuss later.

We exploit the dining hall data to identify members of each student's social network. We infer that a social relationship exists between any two students who enter a dining hall together with sufficient frequency. Accordingly, to classify two students as friends, we specify a time window and define a 'meeting' as any occasion when both students enter the same dining hall within that window. Next, we set a meeting threshold such that we consider two students to be friends in any quarter when their number of meetings equals or exceeds the threshold. After identifying pairs of friends, we then sum an individual's friends made each quarter and then add this for each of the three academic quarters to arrive at our primary measurement of social engagement: *Total Friends*. Since we define a friendship based upon quarterly data and then add these across quarters, our measure of *Total Friends* can count the same friend up to three times. This will occur if two students regularly dine together in all three academic quarters. Thus, the best way to think of the variable *Total Friends* is as a friend-quarter count of significant social interactions.

Table 2 shows the number of friendship pairs observed using alternative time windows and meeting thresholds. For example, using the 30 s time window and ten-meeting-per-quarter threshold, there are on average 20,462 pairs of students who dine together over the course of an academic year. When this threshold is increased to twenty – meaning individuals need to enter a dining hall twenty times within 30 s before being considered friends – there are about 10,825 friendship pairs.

Taking Table 2 as a whole, it is clear that more pairs of individuals are classified as friends when either the time window lengthens or the meeting threshold decreases. This is indicative of a potential tradeoff between measurement error and the strength-of-friendship measured by *Total Friends*. For instance, at very low meeting thresholds, we may misclassify a pair of students as friends simply because two random individuals happened to enter the dining hall at the same time more than once. This introduces measurement error in our models by assigning a friend to an individual who did not actually have one. Of course, this can be mitigated by making the meeting (and time) threshold more stringent. As we do this, we eliminate the number of students incorrectly assigned as friends and increase the likelihood of identifying pairs of students who are strong friends. Thus, the most stringent thresholds likely detect very good friends – for instance the 46 friendship pairs who enter the dining hall at least 60 times within five seconds of each other are eating together about once per day and are almost certainly not the result of chance encounters.

Given the tradeoff between measurement error and strength-of-friendship, we choose a 10-meeting threshold and 30 s time window as our preferred definition of a friend. While there is no

Table 2. Average number of friendship pairs per academic year under various definitions.

	Time Window (seconds)			
Quarterly Meeting Threshold	5	10	30	60
1	147818	568973	2053613	3693764
2	25158	78255	452824	1177232
3	16815	36347	125347	395696
4	13058	28253	59489	164025
5	10594	24054	38963	80564
10	4844	14284	**20462**	23210
15	2617	9737	14561	15824
20	1510	6964	10825	11714
25	898	5046	8221	8911
30	547	3713	6320	6861
40	219	2040	3723	4055
50	94	1101	2140	2363
60	46	592	1188	1318

Notes: All averages are rounded to the nearest whole number. The number of friendship pairs designated using our preferred friendship criteria of 10 meetings within 30 s is in bold.

obvious 'correct' definition, later we demonstrate that our results are robust to a wide range of meeting thresholds and time windows. Using our preferred definition, we summarize friendships and retention across quarters in Table 3. The average number of friends that a student has over the course of the academic year is 6.85 with a standard deviation of 6.42. Students average more friends in the fall (2.68) than the winter (2.41) or the spring (2.05). During their freshmen year, 95% of students who attend in the fall also attend in the winter and 96% of students who attend in the winter attend that spring, which means that roughly 9% of students drop out before the beginning of spring quarter during their first academic year which partially accounts for the decreasing average count of friends from fall to winter and winter to spring.

In Figure 1 we show a histogram of our preferred measure of *Total Friends* over the academic year. While the average student has 6.85 friends, there are a small number of students with many friends: the 95th percentile of the distribution occurs at 19 friends and one person has 50 friends under our preferred definition. Figure 1 also shows that about 17% students have no observed friends. Most of these individuals entered the dining hall so few times that they did not have a chance to make friends under our ten-meeting threshold. These are primarily local students from the area surrounding WWU who live and likely eat at home. In practice, all freshmen who live on campus enter the dining halls often enough to make friends under our definition. Because our friendship measure requires students to eat in the dining halls and we assign zero friends to students who do not, it is important to control for dining hall use when analyzing friendships. Panel A of Figure 2 shows a histogram of total dining hall entries over the course of the year, with the average number of friends for each histogram bin shown in Panel B. Because students who eat less frequently in the dining hall are expected to have fewer friends under our definition, the *Total Friends* measure almost certainly undercounts actual friendships.

We handle this issue in two ways. First, we directly control for dining hall entries and thus produce estimates of the friendship effect as if we were comparing two individuals who dine equally but have a different number of friends. Second, we conduct sensitivity analyses where we restrict the sample to only those entering dining halls often enough to have the opportunity to make friends – ten times in a quarter under our preferred friendship criteria. This last approach eliminates students who live off campus and who were assigned zero friends under our methodology.

As a robustness check, we also conduct our analysis using two alternative measures of social behavior. First, a student might be highly socially engaged despite having relatively few friends if he or she dines with those friends very frequently. We therefore introduce the percent of meals eaten without a friend as an alternative negative measure of social behavior. To be clear, this measure computes the percent of dining hall entries made by a student in which none of their identified friends are present. Second, to assess whether more persistent friends have a stronger impact on retention, we define *Friends in Multiple Quarters* as the total number of friendships that persist for more than one quarter. To be friends in multiple quarters, two students must be defined as friends in two or more quarters.

To validate our friendship measures, Table 4 compares the characteristics of all possible pairings of first-year students with the characteristics of pairs that we designate as friends. Prior research has found that friendships demonstrate homophily, or the tendency for friendships to form between

Table 3. Average number of friendships and student retention across quarters.

	(1) Academic Year	(2) Fall	(3) Winter	(4) Spring
Friends	6.85	2.68	2.41	2.05
	(6.42)	(2.48)	(2.50)	(2.26)
Fraction retained from previous quarter	–	–	0.95	0.96
Observations	17,177	17,177	16,380	15,664

Notes: Standard deviation in parentheses. Friendships are student pairs who enter the same dining hall within 30 s of each other on 10 or more occasions in a quarter. Column 1 averages the total number of friends summed across three academic quarters.

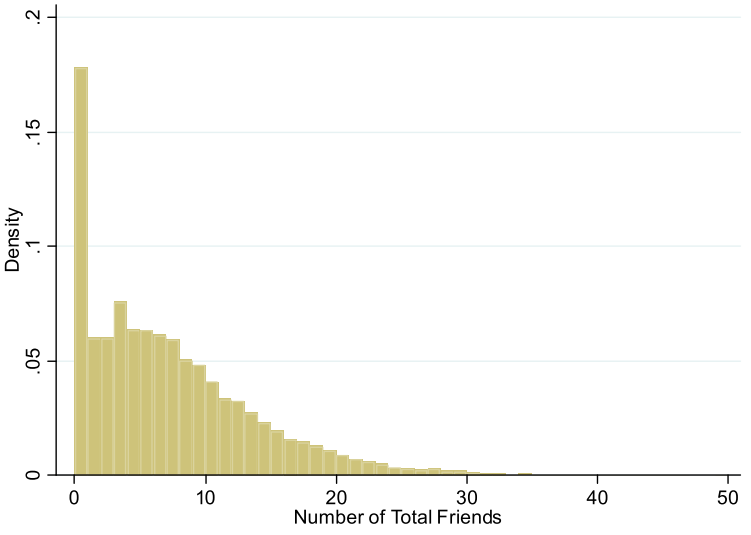

Figure 1. Distribution of *Total Friends*, preferred friendship criteria. *Notes*: Friendships are student pairs entering the same dining hall within 30 s of each other on ten or more occasions in a quarter.

individuals with shared characteristics.[15] As examples, homophily among friends has been found along the dimensions of gender, age, ethnicity, behavior, and occupational interest.[16] Under our preferred definition of friends, Table 4 shows that friends are particularly more likely to share the same home address zip code, high school, ethnicity, and gender. Homophily appears slightly stronger for pairs of students identified as friends in multiple quarters though it is still quite strong for pairs identified as friends in just a single quarter. This, along with the improbability of repeatedly entering a dining hall with the same stranger within relatively short time windows, provides evidence that the pairs of students we identify as friends have a social relationship.

Figure 3 presents the primary relationship our paper focuses on: the relationship between friendships and second year retention. The *Total Friends* measure in Figure 3 is determined by the preferred ten meeting/30 s criteria. Figure 3 clearly shows a general, positive relationship between friends and retention. The open question is whether friends cause this outcome or if this is attributable to omitting relevant variables or simultaneity between retention decisions and friendship formation. We turn to identifying this relationship in the next section.

3. Empirical model and identification strategy

To understand the effect of friendship on retention, we estimate a logit model of the form:

$$\Pr(Retain_i = 1) = \alpha \times TotalFriends_i + X_i'\gamma + T_i'\delta \quad (1)$$

where *Retain* is a binary variable equaling one if student *i* returns to WWU during their sophomore year and 0 otherwise. Our primary interest is in estimating α which represents the marginal effect of an additional friend on the probability of retention.[17] We include two categories of covariates in the vectors X_i and T_i. X_i contains the student-level variables shown in Table 1. Included in this list are the five binary variables representing a student's EFC quintile, binary variables for students' race/ethnicity, first generation status, Pell grant eligibility, in-state residency, gender, whether the student participated in a high school dual credit program, and whether the preferred field of study was not stated at the time of college application. Five binary variables representing the different responses to the pre-matriculation survey question on the likelihood of transferring out of the university are in X_i, as are continuous variables representing high school GPA, SAT score, total dining hall entries,

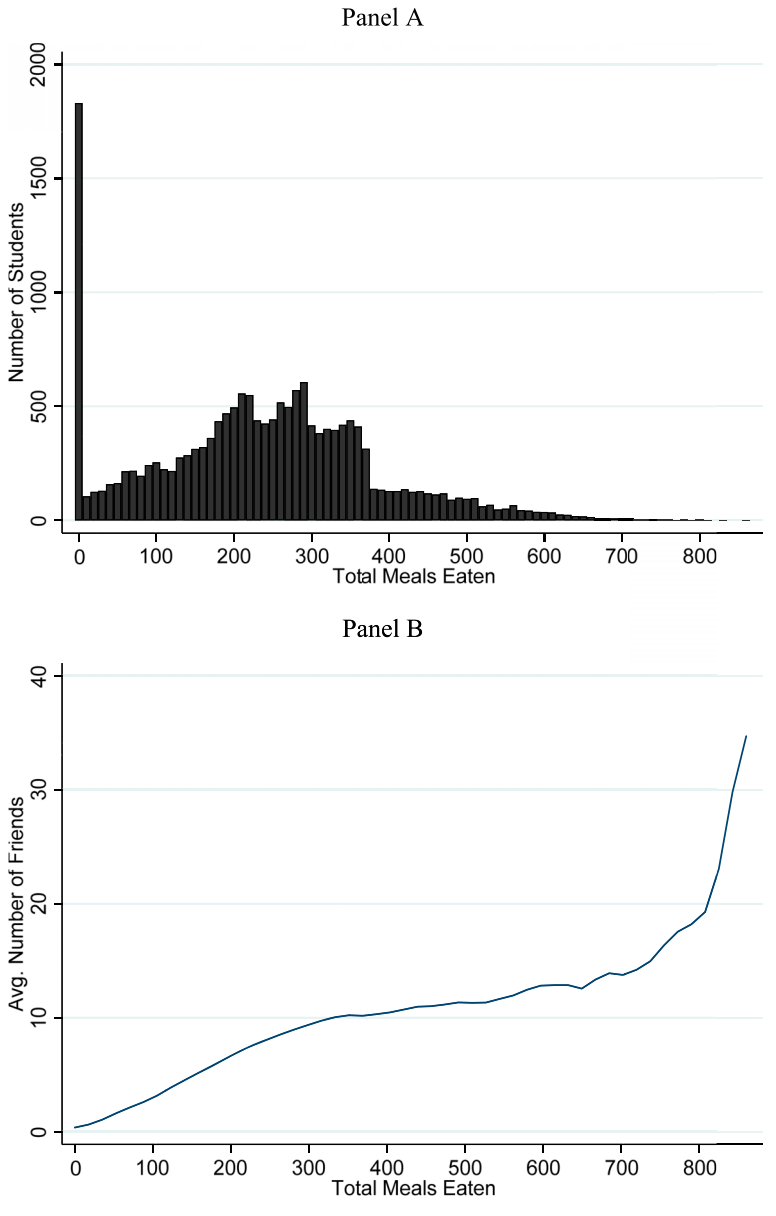

Figure 2. Total dining hall entries and average number of friends. *Notes*: Friendships are student pairs entering the same dining hall within 30 s of each other on ten or more occasions in a quarter.

hours registered in fall quarter, and age at time of starting at WWU (in months).[18] The vector T_i contains time binary variables indicating the academic year in which a student first enrolled at WWU. We estimate equation (1) using our preferred measure of *Total Friends*. However, we also present a comprehensive sensitivity analysis using many other meeting/time combinations as well as those utilizing the percent of meals eaten without a friend and *Friends in Multiple Quarters*.

One threat to identifying α as a causal impact of friends on retention is omitted variable bias. Certain unobservable characteristics of a student's personality might impact both retention and friendship formation. Specifically, students who prefer to dine in the company of others may also be more likely to persevere in college. To address this potential bias, we introduce three measures

Table 4. Characteristics of friendship pairs vs. all pairs of students in the sample.

	2018–2019			2017–2018			2016–2017		
	friends in			friends in			friends in		
	multiple quarters	any quarter	all pairs	multiple quarters	any quarter	all pairs	multiple quarters	any quarter	all pairs
same gender	0.770	0.723	0.516	0.797	0.729	0.515	0.786	0.751	0.516
both male	0.323	0.302	0.168	0.365	0.320	0.171	0.364	0.333	0.168
both female	0.447	0.421	0.348	0.432	0.410	0.343	0.422	0.417	0.348
same ethnicity	0.596	0.578	0.499	0.595	0.591	0.517	0.635	0.614	0.550
both white	0.547	0.526	0.470	0.563	0.555	0.492	0.593	0.574	0.528
same high school	0.203	0.162	0.005	0.228	0.189	0.005	0.188	0.157	0.004
same zip code	0.099	0.081	0.004	0.111	0.087	0.004	0.097	0.081	0.004
Observations	**4742**	**9504**	**10,045,730**	**4428**	**9234**	**9,214,260**	**4434**	**9,254**	**7,865,220**
	2015–2016			**2014–2015**			**2013–2014**		
	friends in			friends in			friends in		
	multiple quarters	any quarter	all pairs	multiple quarters	any quarter	all pairs	multiple quarters	any quarter	all pairs
same gender	0.781	0.740	0.515	0.809	0.757	0.511	0.785	0.733	0.512
both male	0.332	0.310	0.170	0.404	0.358	0.182	0.357	0.324	0.178
both female	0.449	0.430	0.345	0.405	0.399	0.329	0.428	0.410	0.334
same ethnicity	0.564	0.562	0.497	0.586	0.590	0.524	0.603	0.605	0.557
both white	0.518	0.517	0.467	0.540	0.549	0.496	0.560	0.567	0.533
same high school	0.166	0.141	0.005	0.164	0.139	0.005	0.169	0.144	0.005
same zip code	0.083	0.070	0.005	0.085	0.072	0.005	0.100	0.082	0.005
Observations	**4988**	**9938**	**7,412,006**	**5716**	**10,946**	**7,368,510**	**5952**	**11,744**	**7,439,256**

Notes: Friendships are student pairs who enter the same dining hall within 30 s of each other on 10 or more occasions in a quarter. 'Friends in multiple quarters' refers to friendships that persist for more than one quarter, 'friends in any quarter' refers to friendships observed in one or more quarters. 'All pairs' are the outcomes from pairing all first-year students in the analytic sample in each academic year in the data. Characteristics are reported for friendship pairs where both students in the pair are in the analytic sample. Friendships between first-year freshmen and transfer students or continuing upper-level students are not included.

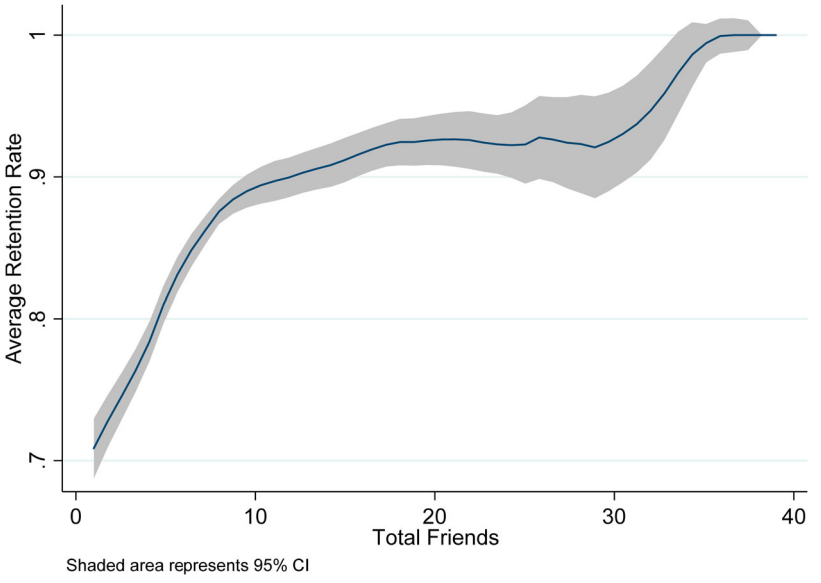

Figure 3. Average retention rate by number of total friends. *Notes*: The retention rate measures the percent of students who continue to enroll in their second academic year. Friendships are student pairs entering the same dining hall within 30 s of each other on ten or more occasions in a quarter.

of friendships: *Fall Friends*, *Winter Friends*, and *Spring Friends,* each of which measure the number of friends made in the respective quarter using our preferred ten meeting/thirty second criteria. We then use *Fall Friends* and *Winter Friends* to control for a student's taste in having friends and estimate the effect of *Spring Friends* on retention. We find that students with more friends at the end of the academic year are more likely to be retained, holding constant the number of friendships established earlier. We also split the sample based upon the number of fall friends made and estimate the friend effect for students above and below the median number of *Fall Friends*. We find the impact of *Spring Friends* is larger for those with few *Fall Friends*, but in both cases an additional friend raises the probability of retention. Both of these approaches suggest that the relationship between retention and friendships is not due to inherent friendliness or unobserved characteristics correlated with early-year friendships and retention.[19]

A similar threat to identification is that friendships and retention decisions are made simultaneously. A student intending to leave the university after one year may invest little energy into making friends during that year. If so, we would estimate a positively biased α – students with few friends are unlikely to be retained not because they have few friends but because they were not committed to the university to begin with. We control for this lack of commitment using students' answers to the survey question 'How likely is it that you will transfer from WWU to another college or university before you graduate?' We also offer a specification of (1) with the sample restricted to students who reported they were very unlikely to transfer from WWU before graduating.

While the use of the survey question may limit the simultaneity bias that exists if uncommitted students attend WWU and then leave without friends, there is a chance that students who were initially highly committed have a poor experience during their first year and as a result, stop making friends and simultaneously choose to leave the university. Again, this would positively bias α for the same reason as given earlier. To handle this, we add controls for a student's first-year GPA and credit hours attempted at WWU. These proxy variables are meant to mitigate any simultaneity bias caused by a poor experience at school on the hypothesis that a bad experience would influence both friendship formation and measures of academic performance and enrollment.

Our final investigation explores the interplay between student characteristics and friendships. Martin, Wright, and Krieg (2020) show that having an additional friend in a class improves the grades of men more than women. We explore this and other potential heterogeneity along the dimensions of gender, first generation status, high school GPA, state residency, and eligibility for the Pell Grant. In each case we split the sample into two groups, re-estimate equation (1) for each group, and then test for significant differences in α between the samples.

4. Results

4.1 Basic model and sensitivity tests

The first column of Table 5 presents estimates of Equation (1) using the preferred *Total Friends* definition criteria of ten quarterly meetings within thirty seconds of dining hall entry. The coefficients displayed in this table are estimates of the marginal effects estimated at the sample mean of the data. The effect of an additional friend on the probability of retention, α, is 0.6 percentage points – a large and statistically significant amount. To put this number into context, recall that the

Table 5. Estimated marginal effects of friends on retention.

	(1) Full sample	(2) Full sample	(3) Very unlikely to leave	(4) At least 10 dining entries	(5) No missing data
Total Friends	0.006*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
Total Dining Entries /100	0.056*** (0.002)	0.015*** (0.002)	0.044*** (0.004)	0.077*** (0.003)	0.055*** (0.003)
1st Year GPA		0.126*** (0.004)			
1st Year Attempted Credits		0.010*** (0.000)			
SAT/100	0.009*** (0.002)	−0.003* (0.002)	0.005 (0.003)	0.007*** (0.003)	0.010*** (0.002)
HS GPA	0.121*** (0.008)	−0.034*** (0.008)	0.156*** (0.013)	0.103*** (0.009)	0.125*** (0.010)
Male	−0.035*** (0.006)	0.009** (0.005)	−0.033*** (0.009)	−0.057*** (0.006)	−0.038*** (0.007)
First Generation	−0.008 (0.006)	−0.005 (0.005)	−0.007 (0.010)	−0.007 (0.007)	−0.008 (0.007)
WA Residency	0.048*** (0.011)	0.044*** (0.009)	0.031 (0.017)	0.065*** (0.011)	0.057*** (0.013)
Pell Eligible	0.006 (0.015)	0.001 (0.013)	−0.016 (0.022)	0.001 (0.016)	0.009 (0.015)
Fall Quarter Hours Registered	0.007*** (0.002)	0.009*** (0.000)	0.004 (0.003)	0.007*** (0.002)	0.007*** (0.002)
Undecided Field of Study	−0.009 (0.016)	−0.010 (0.013)	0.012 (0.031)	−0.002 (0.016)	−0.009 (0.020)
ln(Distance)	−0.019*** (0.004)	−0.009** (0.003)	−0.014*** (0.005)	−0.007* (0.004)	−0.019*** (0.004)
Black	−0.010 (0.013)	0.001 (0.012)	−0.002 (0.022)	−0.012 (0.014)	−0.012 (0.015)
Hispanic	0.005 (0.013)	0.004 (0.008)	0.027* (0.015)	−0.002 (0.010)	0.009 (0.011)
Dual Credit	0.017** (0.007)	0.022*** (0.006)	0.014 (0.010)	0.013 (0.007)	0.014* (0.008)
1st Quintile EFC	−0.058*** (0.018)	−0.016 (0.015)	−0.053** (0.027)	−0.060*** (0.019)	−0.058*** (0.019)
2nd Quintile EFC	−0.037** (0.018)	−0.010 (0.015)	−0.045** (0.027)	−0.034** (0.019)	−0.038** (0.018)
3rd Quintile EFC	−0.034*** (0.011)	−0.023*** (0.009)	−0.039*** (0.017)	−0.030*** (0.012)	−0.032*** (0.011)
4th Quintile EFC	−0.016** (0.009)	−0.009 (0.008)	−0.024** (0.014)	−0.022*** (0.009)	−0.015** (0.009)
Very Likely to Leave	−0.075*** (0.024)	−0.061*** (0.021)		−0.071*** (0.027)	−0.091*** (0.028)
Somewhat Likely to Leave	−0.082*** (0.013)	−0.063*** (0.012)		−0.064*** (0.014)	−0.071*** (0.017)
Uncertain Likely to Leave	−0.05*** (0.008)	−0.046*** (0.007)		−0.047*** (0.008)	−0.053*** (0.009)
Somewhat Unlikely to Leave	−0.031*** (0.008)	−0.023*** (0.007)		−0.021** (0.008)	−0.029*** (0.008)
Observations	17,177	17,177	6,121	15,327	12,206

Notes: Standard errors in parentheses. *** (**) {*} indicate statistical significance at the 99% (95%) {90%} level. All logit models include the variables listed in the table as well as year binary variables, age in months, and a binary variable indicating high school dual credit student. Columns 1, 2, 3, and 4 include, binary variables indicating if high school GPA or SAT is missing. Columns 1, 2, and 4 also include a binary variable indicating whether the student survey question pertaining to likelihood of leaving is missing.

average retention rate is 81.4% and that the average student has 6.85 friends with a standard deviation of 6.42. Thus, a student with one standard deviation more friends, all else equal, would be 3.85 (= 6.42 × 0.6) percentage points more likely to be retained. Another way to put this into perspective is to compare with other coefficients in Table 1. For instance, a 100-point increase in the SAT score is expected to raise retention by 0.9 percentage points while an increase in high school GPA by one point raises retention by 12.1 percentage points. An additional friend has the equivalent retention effect as about 66 (= 0.6/0.9) SAT points or 0.05 (= 0.6/12.1) high school GPA points.

The first column of Table 5 presents coefficients from the other control variables in equation (1). Importantly, these include the total dining hall entries which, as explained above, is directly connected to creating the *Total Friends* measure. The inclusion of dining entries means that the interpretation of the coefficient on *Total Friends* can be thought of as a comparison of two individuals who enter the dining hall the same number of times but who have a different number of friends. Students entering the dining hall more often can be expected to retain at a higher rate than those entering less often, perhaps because dining hall entry is correlated with campus commitment, nutrition, or a desire to be social. Unsurprisingly, we find that students entering the university more academically prepared, as measured by SAT and high school GPA, are more likely to be retained as are students who are in-state residents and those who participated in Washington's dual enrollment program as high school students. Men are less likely to be retained as are students who originated further from campus. As expected, students in lower quintiles of EFC are less likely to be retained than those in higher quintiles. Eligibility for the federal Pell Grant however is not statistically significant, most likely the result of simultaneously controlling for EFC. Finally, answers to the survey question 'How likely is it that you will transfer from WWU to another college or university before you graduate?' are also predictive of retention. Those indicating that they are either very or somewhat likely to transfer out are respectively 7.5 and 8.2 percentage points less likely to return in the second year than a student answering 'very unlikely' (the omitted category).

Before exploring the other columns of Table 5, we investigate the sensitivity of the friend effect to different definitions of *Total Friends*. Specifically, using different meeting thresholds and time windows, we create alternative measures of *Total Friends* and re-estimate the model of column 1, Table 5. Figure 4 presents point estimates and 95% confidence intervals of α for different meeting and time criteria. As Figure 4 shows, for all definitions of *Total Friends*, estimates of α are positive and, other than those at the high meeting thresholds which tend to have few observations of friends, are statistically different than zero. The coefficient estimates generally rise with the meeting threshold, suggesting that more strict definitions of what constitutes a friend leads to a larger estimated impact of those friends on retention. The coefficients also tend to be larger when shorter time windows are used, suggesting that entries within a very short time could identify stronger friends who have a larger effect on retention than weaker ones. Taken as a whole, Figure 4 demonstrates that even under a wide variety of friendship criteria, friends positively impact retention.

Returning to Table 5, the second column augments the first by including students' college GPA during their first year and the number of attempted credits during that year. These variables are included to control for unobserved factors correlated with student success and friendship formation. Because retention decisions and academic performance are likely to be simultaneously determined, we caution against interpreting these results as causal. However, because academic success may be impacted by outside events influencing both retention and friendship formation, we include these measures to gauge the sensitivity of the *Total Friends* coefficient. Although adding them does reduce estimates of α, the estimates remain strongly statistically significant and suggest a 0.4 percentage point increase in the probability of retention per friend.

Column 3 of Table 5 restricts the sample to students who indicated in the pre-matriculation survey that they were 'very unlikely' to leave WWU prior to graduating. The purpose of this restriction is to eliminate any bias in α caused by students who attend the university with the intention of

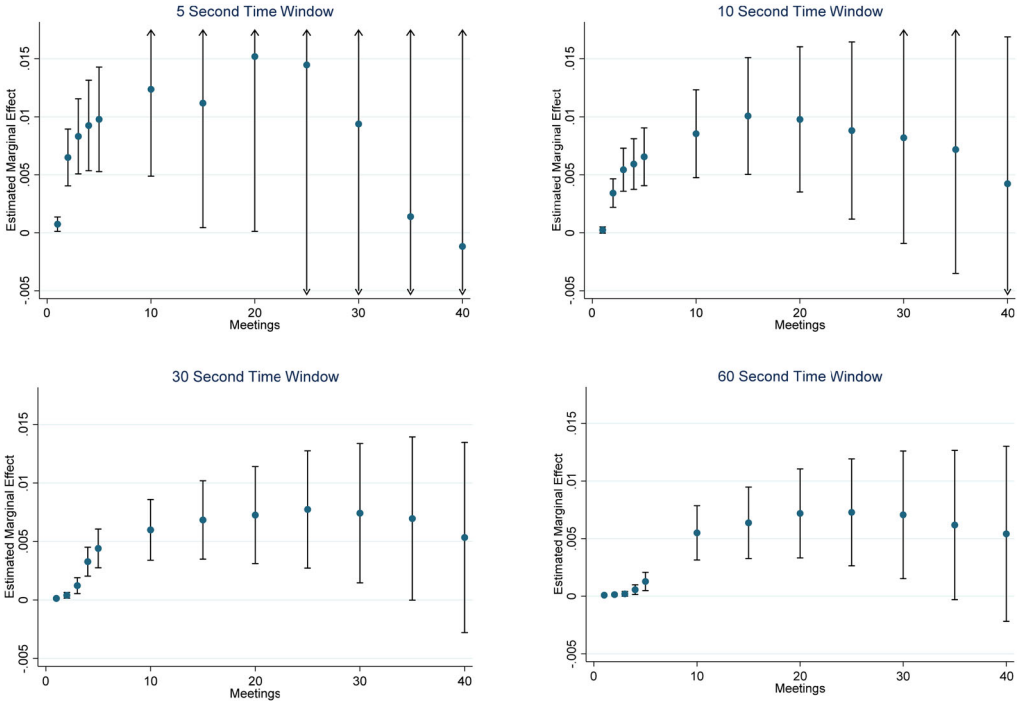

Figure 4. Estimated marginal effects of total friends on retention, by alternate friendship criteria.

Notes: Each dot represents the point estimate of the friend effect for different friendship criteria (time windows and meeting thresholds) from our preferred specification in column 1 of Table 5. The corresponding bars represent the 95% confidence interval. Our preferred friendship criteria are 10 or more meetings within 30 s in a quarter. Arrows indicate that confidence interval bounds are outside of the y-axis scale.

leaving quickly and consequently choose not to invest in friendships. Although this restriction reduces the sample size by about two-thirds, the effect of *Total Friends* remains positive and statistically significant.

The fourth column of Table 5 restricts the sample to students who enter the dining hall at least ten times in a quarter and thus have an opportunity to make at least one friend under our preferred definition, which eliminates the ten percent of first-year students who live off campus. Previously, students dining fewer than ten times in a quarter were mechanically assigned zero friends – which almost certainly introduced several false negatives. As shown in column 4, restricting the sample to those students who have a chance to make at least one friend does not change our estimates of the friend effect.

As an additional sensitivity test, we restrict the sample to only students who have a complete set of independent variables. Recall from Table 1 that 3.1% of observations are missing SAT scores, 1% of observations are missing high school GPAs, and 25% are missing a response to the survey question. The earlier models of Table 5 handle these missing data by assigning a zero value to each missing variable and including a binary indicator for whether the variable was missing. Column 5 of Table 5 limits the sample to students with no missing values in any of these three variables. While the sample is reduced by about 30%, the estimated marginal effect of friends on retention remains at 0.6 percentage points.

In Table 6, we report estimates of the friend effect using our alternative measures of social connectedness. Results from our preferred specification in column 1 of Table 5 are presented in the first column of Table 6 for reference. According to the results in column 2, each friendship that persists for more than one quarter increases the probability of retention by 2 percentage points. This is in line with the results using *Total Friends,* because a friendship that lasts for all three quarters in the

academic year would increase *Total Friends* by three and hence increase the predicted probability of retention by 1.8 percentage points (= 3×.006). Column 3 of Table 6 utilizes the measure of the percent of meals eaten with no friend present and shows that students who never eat with friends are 4.5 percentage points less likely to be retained than those who always eat with at least one friend.

4.2 Friendship timing and early attrition

One concern about the preceding analysis has to do with early attrition. About five percent of students leave the university between fall and winter quarter, and an additional four percent leave between winter and spring. Because the *Total Friends* variable sums friends across all three academic quarters, students who leave early will have fewer observed friends than those who stay the entire year. Since students who leave in the middle of the year are very unlikely to return the following fall, this leads to a potential positive bias in estimated effect of friends on retention.

We address this by creating variables that measure the number of friends made in each quarter using our preferred ten meeting/thirty second criteria: *Fall Friends*, *Winter Friends*, and *Spring Friends*. We then estimate the effect of the friends made each quarter conditional upon the student returning the following quarter. For instance, column 2 of Table 7 shows the effect of an additional friend made in fall quarter for students who also return to the university in the following winter. The purpose of this restriction is to guarantee that our results are not driven by students who leave the university during the fall quarter and thereby have fewer observed friends than a student who completes the entire quarter. For comparison, column 1 of Table 7 shows the effect of *Fall Friends* for the full sample (with no condition placed on enrollment in the subsequent quarter).

Comparing the first and second columns of Table 7 suggests that eliminating students from the sample who do not return in the winter does reduce estimates of the friend effect by about one-third. We perform the same exercise on students between the winter and spring quarters in columns 3 and 4 and again see a reduction in the estimates of the friend effect. However, in both cases, the smaller estimates remain consistent with what we found before: an additional friend raises the probability of retention by around 0.6 percentage points.

As column 5 of Table 7 shows, the estimated effect of a friend in the spring quarter is about triple this amount suggesting that friends made closer to the following fall retention decision are more important than earlier friends. We explore this further by simultaneously including *Fall Friends*, *Winter Friends,* and *Spring Friends* (column 6) and these same variables with the restriction that students made it through winter quarter into spring (column 7). In both cases, we find that spring friends are much more important in influencing retention than friends from earlier quarters. By including *Fall Friends* and *Winter Friends* in columns 6 and 7, we can interpret the coefficient on *Spring Friends* as comparison of two people who have the same number of friends early in the academic year, but a different number later. According to the results, the student who has more friends at the end of the academic year is more likely to be retained. Assuming that *Fall Friends* and *Winter Friends* control for a student's friendliness or similar personality traits that affect social behavior and

Table 6. Estimated marginal effects using alternative measures of friendship.

	(1) Full sample	(2) Full sample	(3) At least 10 dining entries
Total friends	0.006*** (0.001)		
Friends in multiple quarters		0.020*** (0.011)	
Percent of meals eaten without a friend			−0.045*** (0.011)
Observations	17,177	17,177	15,327

Notes: Standard errors in parentheses. *** (**) {*} indicate statistical significance at the 99% (95%) {90%} level. All logit models contain the full set of variables included in column 1 of Table 5.

Table 7. Estimated marginal effects of friends on retention, by academic quarter.

	(1) Full sample	(2) Persist to Winter	(3) Full sample	(4) Persist to Spring	(5) Full sample	(6) Full sample	(7) Persist to Spring
Fall Friends	0.012***	0.008***				0.003*	0.002
	(0.0015)	(0.0014)				(0.0018)	(0.002)
Winter Friends			0.013***	0.006***		0.001	−0.001
			(0.0016)	(0.001)		(0.0024)	(0.002)
Spring Friends					0.017***	0.013***	0.010***
					(0.0021)	(0.0026)	(0.002)
Observations	17,177	16,380	17,177	15,664	17,177	17,177	15,664

Notes: Standard errors in parentheses. *** (**) {*} indicate statistical significance at the 99% (95%) {90%} level. All logit models contain the full set of variables included in column 1 of Table 5.

retention, this reduces the likelihood of bias caused unobserved time-invariant student characteristics.

4.3 Heterogeneity

Finally, we investigate whether the friendship effect varies across different types of students. In Table 8, we split the sample into different groups and re-estimate equation (1) for each group. Specifically, we look at gender, first generation status, high school GPA (split at the sample median), Washington residency status, Pell eligibility, and if a student had a high or low number of friends in the fall quarter (again, split at the sample median). In each case we hypothesize that a friend might have a different effect for students across these categories. For instance, Martin, Wright, and Krieg (2020) show that an additional friend has a stronger impact on the academic performance of men and first-generation students than on women or non-first-generation students. One could imagine friends having a larger retention impact on students who are on the margin of staying in school – perhaps those with weaker academic backgrounds or less connection to higher education.

Table 8 presents the results of the heterogeneity analysis. Estimates of the friend effect are positive and statistically significant for all subgroups, showing that social networks are important for each type of student in this table. However, as shown in the second row of the table, only three analyses show a statistical difference between groups. Students with above-median high school GPAs (3.47) experience a marginal effect of friends that is slightly larger (0.1 percentage point) than those with below-median GPAs, while the friend effect for out-of-state students is nearly double that of students from Washington state (0.5 percentage points higher). To put these differential effects in terms of SAT points, the former would equate to a roughly 11-point increase while the latter would be an approximately 55-point increase. Plausible explanations exist for both: one might imagine an additional friend is more important to students coming from out-of-state because they lack established social networks relative to their in-state peers. Likewise, the presence of friends on campus may weigh larger in the decision to return to campus for students who arrive better prepared relative to those at the margins of academic preparation to begin with.

The third statistical difference in Table 8 has to do with splitting the sample by the number of friends made in fall quarter (shown in columns 13 and 14). To avoid endogeneity, we estimate the effect of a spring friend in each of these samples. For students who have more than the median number of friends in the fall quarter (2 friends), an additional spring friend raises the likelihood of retention by 1.1 percentage points. For those with fewer than the median number of fall friends, an additional spring friend more than doubles the effect on retention to 2.7 percentage points. By splitting the sample, we partially control for unobserved ability to make friends by comparing students with similar experiences in making friends during the fall quarter and continue to find that even those students who made few friends early in their freshmen year benefit greatly from additional future friends.

Table 8. Estimated marginal effects of friends on retention, by student characteristics.

Student Characteristic	(1) Men	(2) Women	(3) First Generation	(4) Not First Generation	(5) HS GPA <= median	(6) HS GPA > median	(7) WA Residents	(8) Non-residents	(11) Pell eligible	(12) Not Pell eligible	(13) Fall Friends <= Median	(14) Fall Friends > Median
Total Friends	0.006***	0.006***	0.006***	0.006***	0.006***	0.007***	0.005***	0.010***	0.006***	0.006***		
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)		
Spring Friends											0.027***	0.011***
											(0.005)	(0.002)
P-Value from Test of Coefficient Equality	0.400		0.538		0.016**		0.052*		0.323		0.020**	
Observations	7,139	10,038	5,445	11,742	8,460	8,717	14,800	2,376	4,277	12,898	9,444	7,773

Notes: Standard errors in parentheses. *** (**) {*} indicate statistical significance at the 99% (95%) {90%} level. All logit models contain the full set of variables included in column 1 of Table 5.

5. Conclusion

This paper employs a revealed-preference method of determining friendships and demonstrates that students with more friends are more likely to return for their second year at a mid-size, public US comprehensive university. This increase in retention probability is significant both statistically and practically, with an additional friend having about the same impact on retention as a 66-point increase in SAT scores. This effect occurs in the presence of a robust set of explanatory variables, including ones that help control for students who may not be committed to the university and thus be simultaneously more likely to leave and to make fewer friends. This finding is also robust to controlling for the number of friends in prior quarters which mitigates concerns of unobserved factors that might simultaneously impact friendship formation and retention decisions. Though we have taken many steps to address potential endogeneity issues, identifying plausibly exogenous variation in students' social networks remains a difficult empirical problem. Given the large positive relationship between friends and retention found in this paper, and the significance of friends found in other settings, further research into the causal effects of social connections is certainly warranted.

If friends are associated with college retention, it is worth considering policies that promote friendships between students. Universities typically create programs and structures that increase social interaction, such as campus clubs, housing preferences, first-year experiences, and small class sizes. One particularly successful type of program in improving students' retention is Living Learning Communities (LLCs), which creates a peer community for first-year students by assigning students with similar interests to common dormitories and courses. Previous research has found these to be a relatively cost-effective method to increase retention (Caviglia-Harris 2022).

To the extent that these programs foster friendships, they may have indirect benefits that outweigh the costs. However, since our work does not shed light on how friendships are formed, we cannot assess which policies might increase the type of friendships that encourage college students to stay in school. What is clear is that recent changes in higher education are likely to inhibit this type of social interaction. For instance, the rise of online classes likely makes it much more difficult to form the type of friendships our dining data measures. This has been exacerbated by the Covid pandemic, which led most colleges to move to an online format and then, upon returning to in-person learning, to create an environment with much more limited social interaction. To the extent that these efforts weaken student social networks, the results from this paper suggest this has potentially important consequences for college retention and thus completion.

Notes

1. See (OECD 2022), Table B5.1.
2. Data from the 2021 Current Population Survey show that relative to high school graduates, those with some college but no degree had only 8% higher annual earnings while those with a bachelor's degree earned 63% more (NCES 2022b).
3. The primary drawback of using survey data to build social networks is that nominated friendships may entail varying degrees of social interaction both within and across respondents that are unobservable to the researcher. See Martin, Wright, and Krieg (2020) for a detailed discussion.
4. The academic year for the university in this study consists of three equal-length quarters: fall, winter, and spring. Section 2.1 provides further explanation and institutional details.
5. This issue could be mitigated by the inclusion of a student fixed effect, but this is not possible since the outcome of interest, second-year retention, is only observed once per student.
6. See Martin, Wright, and Krieg (2020) for a review of this literature.
7. Dewberry and Jackson (2018) and Swenson Goguen, Hiester, and Nordstrom (2010) are exceptions in that they do not find statistically significant effects of friends on retention.
8. The authors construct what they call an "*m*-index," where *m* is the maximum number of times a student's dining card was swiped within one minute of *m* other students. We discuss the difference in our friendship-determination procedure below, where friendships are binary symmetric relationships based on the timing and frequency of dining card swipes.

9. Bowman et al. (2019a) find that measures of friendship early in the academic year are predictive of retention but our analysis shows that fall measures of social networks are only weakly predictive of retention when spring friendships are accounted for.
10. Most recently, WWU has a 6-year graduation rate of 68%. Of the 32% who did not graduate within 6-years, 3/5ths left the university between their first and second year on campus.
11. The IPEDS definition of a first-time students is "A student who has no prior postsecondary experience … attending any institution for the first time at the undergraduate level. It includes students who … entered with advanced standing (college credits or recognized postsecondary credential earned before graduation from high school) (IPEDS 2022)."
12. To apply for financial aid, students must submit a FAFSA (Free Application for Federal Student Aid).
13. The federal Pell grant awards up to $6845 to cover educational expenses of students from low-income families.
14. The few campus residences with kitchens are primarily occupied by advanced students rather than freshmen.
15. See, for example, Block and Grund (2014).
16. See Goodreau, Kitts, and Morris (2009), Smith-Lovin and McPherson (1993), Fischer (1977), Knecht et al. (2010), and Kalmijn (1998).
17. We report the marginal effects estimated at the sample mean for each variable.
18. In order to scale the marginal effects coefficients, we divide SAT and total dining hall entries by 100.
19. We also use the number of friends made in each quarter to handle the small number of students who leave before the end of the academic year. Because mid-year dropouts will necessarily have fewer measured friendships, we present models that restrict the quarterly samples to students who enroll in a quarter and then return the following quarter.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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