Factors Affecting the Retention of Students Admitted from CEGEP

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Abstract

Using administrative data, I investigate the factors that affect retention of CEGEP students in undergraduate studies at the University of Ottawa. I estimate a linear probability model for first and second year retention rates. I find that age, sex, difference in financial costs, and enrollment in the Faculty of Arts and the Faculty of Social Sciences crucially affect both first year and second year retention. A surprising finding is that the admission average has a positive effect on the second year retention rate but does not affect first year retention. The citizenship status of the student affects first year retention, but does not affect second year retention.

Content

1. Introduction

There is a significant variety of research which has investigated the factors which determine the retention rates of undergraduate students. The retention rate is defined as the percentage of undergraduate students who continue to register in their program for another year of study, and is considered to be an indicator of student satisfaction. Low retention rates will result in lower graduation rates, potential financial losses and may adversely affect the reputation of the university (Delen, 2010). The University of Ottawa admits students directly from high school. In addition, however, there is a significant intake from Quebec CEGEPs. Strikingly, the retention rates for the CEGEP students after first and second year of study at uOttawa is 82.49% and 75.04%, respectively, which is lower than the first and second year retention rates for the university as a whole (87.2% in 2014). However, students admitted from CEGEP appear to be doing relatively well academically: it is therefore a puzzle to explain why they are not persisting in their studies at uOttawa.

This paper focuses on the factors affecting first and second year retention rates for

students pursuing study at uOttawa who were admitted from CEGEP. There are no other studies that have studied retention rates for out-of-province students in Canada, thus it would be interesting to study retention rates for students who study across provinces. Previous researches proposed that age, sex, admission average, program language, whether the student is local, CGPA in the first year and citizenship are key factors affecting retention rates ((Angrist, Lang & Oreopoulos (2009); Beattie, Laliberté & Oreopoulos (2016); Bettinger, Long, Oreopoulos & Sanbonmatsu (2012); Bean (1980); Childs, Finnie & Martinello (2017); Delen (2010); Herzog (2005); Hochstein & Butler (1983); Hu & John (2001); Leppel (2002); Singell (2004); Wohlgemuth *et al* (2007); Wetzel, O'Toole & Peterson (1999)), but there are no studies which have highlighted the role of financial cost difference. Thus I construct financial cost difference variable, which reflects difference in tuition and living costs between uOttawa and Quebec universities, as well as scholarships. Besides, I include the faculty that the student admitted as a new factor, which is not mentioned in previous literature. In addition to studying retention rates, I also use OLS to examine the determinants of academic performance (CGPA).

In this paper, I use the linear probability model to estimate the crucial factors that affect retention rates of CEGEP students. These findings may help other researchers to be aware of the effect of differences in financial costs and of the faculty of admission on retention rates. It may also assist the institution in optimizing its policies to improve retention in the university.

The structure of this paper is as follows. In section 2, I briefly introduce the CEGEP program. Section 3 presents the related literature review on retention that is useful to identify the potential explanatory variables. Section 4 describes the data. Section 5 discusses the methodology. Section 6 presents the result of the regression analysis. Finally, section 7 concludes.

2. A Brief Introduction to the CEGEP Admission Pathway

The CEGEP program is a public pre-university education program offered exclusively by the province of Quebec in Canada. It is a transition program between secondary

school and university[1]. Students in Quebec who want to pursue post-secondary education after 5 years of high school need to complete two years of CEGEP before they apply to university. Students in Quebec without a CEGEP diploma cannot enter university in Quebec.

Unlike high school, CEGEP provides more specialized programs. Students choose the field in which they are interested, and follow pre-university courses related to this field, thus getting a better understanding of what university study entails. A key purpose of CEGEP is to make sure that students in Quebec are well prepared for university education.

Students in CEGEP who apply to a university in Ontario must satisfy the requirements of the admitting institution, Importantly, they can apply to an Ontario university after only one year of CEGEP courses, and are treated like Ontario applicants who have completed grade 12. These students cannot be admitted to Quebec universities with only one year of CEGEP.

[1] Technical programs are also offered for students who do not plan to go to university.

CEGEP programs can be found that offer programs of study in both French and English. Unlike pre-CEGEP schooling, students can choose to study in the language they prefer[2].

3. Literature Review

Student retention rates at university are of ongoing concern to decision makers in academic institutions and in government. An extensive academic literature has sought to uncover factors that affect student retention rates in undergraduate education. Below, I provide a brief review of some of the variables that other researches have found have an influence on retention rates.

A number of researchers have studied the link between gender and retention. Female students are more likely to persist in their studies than are males in South America (Angrist, Lang & Oreopoulos (2009); Beattie, Laliberté & Oreopoulos (2016); Bean (1980); Childs, Finnie & Martinello (2017); Hu & John (2001); Leppel (2002);

[2] Some students can choose the language of their high school education, and CEGEP programs are eligibility for English-language high school.

Wohlgemuth *et al* (2007)). In contrast, Herzog (2005) finds that females are more likely to change programs than are males, but does not find any gender difference in the drop out rate.

A number of studies have investigated the impact of past academic performance on achievements in university. One key measurement of past academic performance is high school grades. Many researchers find that students with higher high school grades are less likely to drop out (Childs, Finnie & Martinello (2017); Delen (2010)). Beattie, Laliberté & Oreopoulos (2016) find out that high school grades are a key predictor of college GPA. They categorize students as thrivers (students whose college GPA exceeds expectations) and divers (students whose college GPA is below expectations), and find that thrivers are more likely to persist in their studies than are divers. College GPA, which is an important measure of present academic performance, has a strong positive correlation with retention (Childs, Finnie & Martinello (2017); Delen (2010); Herzog (2005); Hu & John (2001); Leppel (2002); Singell (2004); Wetzel, O'Toole & Peterson (1999); Wohlgemuth *et al* (2007)), but

this factor would lead to endogeneity problem.

Another significant predictor of retention is age. However, there is no consensus about whether age has a positive or negative impact on retention. Some researchers find that older students have a lower retention rate than younger students (Beattie, Laliberté & Oreopoulos (2016); Hu & John (2001); Leppel (2002); Singell (2004)). This may be due to the fact that older students receive lower grades in university (Beattie, Laliberté & Oreopoulos (2016)); however, they also have greater job experience, which may help them to form a clear idea of what their opportunities will be once they obtain their degree (Leppel (2002)). Singell (2004) suggests that this result is accordant with human capital theory, which suggests that older students have less time to obtain the benefits of university.

A number of studies have explored whether or not students from the local community, or state, are more likely to persist than are students who have chosen to enroll in a university situated outside the province (or state) in which they permanently reside.

Herzog (2005) finds that out-of-state (non-local) students are more likely to drop out than are in-state students. Singell (2004) finds that rural students are more likely to persist than are urban students. Wohlgemuth *et al* (2007) find that students who live in university residence on campus are more likely to persist than are students who commute.

A number of American researchers have examined the link between financial aid and academic persistence. An increase in the cost of university decreases the odds of retention (Singell (2004); Wetzel, O'Toole & Peterson (1999)). When students receive an increase in financial support, this leads to increase in persistence (Bettinger, Long, Oreopoulos & Sanbonmatsu (2012); Delen (2010); Hu & John (2001); Singell (2004); Wohlgemuth *et al* (2007)). Hochstein & Butler (1983) find that grants are positively correlated with student persistence while loans are negatively associated with persistence. Herzog (2005) suggests that loans increase the risk that a student will transfer to another institution, but does not actually influence the decision to drop out. In contrast, Garibaldi, Giavazzi, Ichino & Rettore (2012) find that the

relationship between tuition fees and retention is not significant.

Family income is found to be a significant predictor of student persistence. Students from higher income families are less likely to drop out than are students from middle-income and low-income families (Childs, Finnie & Martinello (2017); Herzog (2005); Hu & John (2001); Leppel (2002); Singell (2004)).

Some researchers have examined ethnicity in relationship to retention and have found mixed evidence. Hu & John (2001) find that African Americans, Hispanics, and students from other ethnicities have the same probability of retention as do White students. Leppel (2002) find that female African Americans students have higher retention rates than male African Americans students. Leppel (2002) also finds that Asian ethnicity has a positive impact on retention of both female and male students compare with other ethnicities. Wohlgemuth *et al* (2007) find that ethnic minorities are significantly more likely to drop out in the first year of university. Singell (2004) finds that ethnicity is not a significant predictor of student retention.

A number of other potential factors have been investigated. Childs, Finnie & Martinello (2017) find that students from two parent families are less likely to drop out than are students from single mother families. Single students are more likely to persist than are married students (Leppel (2002); Wetzel, O'Toole & Peterson (1999)). Leppel (2002) finds that having children has a significantly positive impact on female retention rates but a negative impact on male retention rates.

4. Data

This study uses administrative data extracted by the Office of the Registrar of the University of Ottawa. These data includes all students who were admitted to the University of Ottawa between 2010 and 2016 after completing at least one year of study at a CEGEP. The data set contains information on a number of potential explanatory variables in this study, which can be used to identify the factors affecting the retention of students admitted from the CEGEP pathway. Each student is observed for the first two years of the study at the University of Ottawa. Students who drop out after their first year are observed only once.

Variables defined in Table 1. Table 2 reports descriptive statistics for the whole data set. The data set is comprised of 4,814 students, and can be divided into seven cohorts, based on the year in which the students were admitted. Of the entire data set, 15.25% were admitted in 2010, 13.65% were admitted in 2011, 15.02% were admitted in 2012, 14.98% were admitted in 2013, 13.69% were admitted in 2014, 14.73% were admitted in 2015 and 12.69% were admitted in 2016.

The average first year retention rate is 82.49%; this is lower than the first-year retention rate for the university as a whole (87.2% in 2014); the retention rate for second year is 75.04%. Students admitted from CEGEP range in age from 16 years old to 58 years old; the average age is 20 years old. 65.39% of CEGEP students are females. This gender split is somewhat different from the university as a whole: for uOttawa, 60.26% of undergraduate students are females. The admission average of students admitted from CEGEP ranges from 60 to 97.2, and the average admission average is 76.42. No admission average was reported for 61 students. The scholarship average is calculated using the student's best five courses grades in CEGEP;

scholarship averages range from 59.2 to 99.7, and the average scholarship average is 83.12. Below, I use the scholarship average to determine whether the student obtains an admission scholarship. Students' cumulative grade point average (CGPA) after their first year at university ranges from 0.13 to 10; the average CGPA after first year is 6.57. 48.92% of the students admitted from CEGEP come from the Outaouais region close to Ottawa. 30.31% of these students choose to study in English at uOttawa. A full 97.5% of students admitted from CEGEP are Canadian citizens.

CEGEP students are spread across all of the faculties. 15.48% enroll in the Faculty of Arts, 3.3% in the Faculty of Law, 6.34% in the Faculty of Engineering, 11.94% in the Telfer School of Management, 8.35% in the Faculty of Science, 12.36% in the Faculty of Health Sciences, and 42.23% in the Faculty of Social Sciences.

In addition to the administrative data, I also use Statistics Canada data on tuition and living expenses at Quebec universities to better measure the differences in the financial costs of studying at uOttawa rather than at a Quebec university. With very

few exceptions, tuition fees are generally the same across all universities and programs in Quebec. I calculate the average tuition fees and accommodation costs in residences at Quebec universities as compared to the average tuition fees and living accommodation costs charged by the University of Ottawa. Figures 1 and 2 below illustrate the gap between the tuition fees and residence accommodation costs charged by Quebec universities versus uOttawa.

In my analysis, I am particularly interested in discerning the impact of differences in the cost of studying at uOttawa versus a Quebec institution of CEGEP students' persistence. To this end, I construct two financial costs differences variables, FINANCIAL1 (first year), FINANCIAL2 (second year), which reflect the differences in financial costs that a CEGEP student experiences if they choose to study at uOttawa rather than at a Quebec university. The details of the calculation are explained in Section 5: Methodology. These variables take into account differences in tuition and living costs, as well as scholarships. The University of Ottawa offers two kinds of admission scholarships: University of Ottawa Admission Scholarships and

French Studies Bursary[3]. For the University of Ottawa Admission Scholarship, newly admitted students with an admission average of 80% or more automatically receive award between $1,000 and $4,000. Students with admission averages of 95-100% receive $4,000, those with 90-94.9% receive $3,000, students with 85-89.9% receive $2,000, and students with 80-84.9% can receive $1,000. Full-time students who take at least 3 courses taught in French each term would receive the French Studies Bursary ($1,000 per year), and for maintenance of the bursary, students need to maintain full-time enrollment in French courses and maintain a minimum CGPA of 5.5 at the end of each academic year. Table 2 indicates that the financial costs differences in the first year (FINANCIAL1) ranges from $-2022.62 to $6815.18, and the average is $2671.93; the financial costs differences in the second year (FINANCIAL2) ranges from $1977.38 to $6815.18, and the average is $3874.46.

[3] The information of scholarship can be find at https://www.uottawa.ca/financial-aid-awards/scholarships-and-bursaries/general-admission-scholarships-2017-2018

5. Methodology

In this paper, I use the linear probability model (LPM) to estimate the relationship between retention rates and my explanatory variables. The linear probability model can be used to study the relationship between a dichotomous dependent variable, such as retention, and a set of explanatory variables. An alternative to the linear probability model would be a probit model, which is widely used in regression analysis when the dependent variable is a binary variable. The main drawback to the probit model is that the estimated coefficients are difficult to interpret. In contrast, the assumption underlying the linear probability model is that the probability of the outcome is a linear function of the independent variables. As there are no restrictions placed on the estimated coefficients in the LPM, there can be an unboundedness problem. However, if most of the independent variables are categorical variables, this model is unlikely to suffer from the unboundedness problem, and in such circumstances the linear probability model is a good choice. In this paper, the linear probability model is used to estimate the relationship; however, in section 6.4 I also report estimates obtained using the probit model.

The linear probability model can be expressed as:

$$y_i = \beta_0 + \beta_i X_i + \mu_i \; for \; i = 1,2,3, \dots, N$$

where y_i is the binary dependent variable, and is equal to 1 if the student remains enrolled in his/her program, and is equal to 0 if the student drops out; X_i represents the set of explanatory variables, which includes age, sex, admission average from CEGEP, program language at uOttawa, citizenship, and the variable capturing the difference in financial cost; μ_i is the error term.

For the linear probability model, the probability that $y_i = 1$ is equal to the expected value of y_i:

$$P(y_i = 1|X_i, \mu_i) = E(y_i|X_i, \mu_i) = \beta_0 + \beta_i X_i$$

β_i measures the change in the probability of $y_i = 1$ when X_i changes, holding other factors fixed:

$$\Delta P(y_i = 1|X_i, \mu_i) = \beta_i \Delta X_i$$

The estimated equation is:

$$\widehat{y_i} = \widehat{\beta_0} + \widehat{\beta_i} X_i$$

where $\widehat{y_i}$ is the predicted probability of retention. Therefore, $\widehat{\beta_0}$ is the predicted probability of retention when each X_i is equal to zero. The coefficient $\widehat{\beta_i}$ measures the predicted change in the average probability of retention when X_i increases by one unit.

The FINANCIAL variable is constructed as: FINANCIAL = uOttawa tuition + uOttawa living costs – Quebec tuition – living costs where they are permanently located – admission scholarship. Consequently, for students from the Outaouais region, FINANCIAL = uOttawa tuition + uOttawa living costs – Quebec tuition – uOttawa living costs – admission scholarship = uOttawa tuition – Quebec tuition – admission scholarship; for students from other regions in Quebec, FINANCIAL = uOttawa tuition + uOttawa living costs – Quebec tuition – Quebec living costs – admission scholarship.

Several of the studies of retention discussed in my literature review use a

dichotomous variable to distinguish between students from the local community and students whose permanent residence is non-local. As all of the students in my study are from Quebec, the variable "local/non-local" may be correlated with the variable capturing differences in financial costs. Table 3 reports the correlation coefficients for local variable and financial costs differences in first and second year. I find that the correlation coefficient between local variable and financial costs differences in first year is -0.5258, and between local variable and financial costs differences in second year is -0.7453. Consequently, I omit local variable when I estimate the LPM model for first year and second year retention to avoid problems with multicollnearity. As a robustness check, in Section 6.5 I report estimates replacing my financial cost difference variable with local/non-local.

In addition to studying retention rates, I also use OLS to examine the determinants of academic performance. The OLS model can be expressed as:

$$y = \alpha_0 + \alpha_i X_i + \varepsilon_i \; for \; i = 1,2,3, \dots, N$$

where y is the cumulative grade point average after first year in university, X_i

represents the set of explanatory variables, which includes age, sex, admission average from CEGEP, program language, citizenship, the difference in financial cost in the first year, and the faculty which the students is admitted; ε_i is the error term.

6. Results

6.1 First Year Retention Rate

Table 4 reports the estimates for the LPM model for first year retention. In the discussion below, I focus on the baseline specification (my preferred specification). Age, gender, citizenship, the differences in financial costs, and admission to the Faculty of Arts and to the Faculty of Social Sciences all statistically significantly influence first year retention. The fact that age, sex, and citizenship are key factors affecting student retention is consistent with the findings of Beattie, Laliberté & Oreopoulos (2016), Hu & John (2001), Leppel (2002), Singell (2004), Angrist, Lang & Oreopoulos (2009), Bean (1980), Childs, Finnie & Martinello (2017), Wohlgemuth *et al* (2007), Herzog (2005).

The estimated coefficient for age is -.00668, which means that a 21-year-old student is 0.67 percentage points less likely to remain at uOttawa than is a 20-year-old student. The sign of the coefficient estimate of sex is negative: a male student is 2.24 percentage points less likely to persist than is a female student. A Canadian citizen is 7.34 percentage points less likely to persist at uOttawa than is a Permanent Resident. An increase of $1000 in the financial costs differences in the first year decreases the probability of retention by 2.79 percentage points. A student admitted to the Faculty of Arts or to the Faculty of Social Sciences is 6.81 percentage points and 3.87 percentage points respectively less likely to persist. Surprisingly, the admission average from CEGEP is not statistically significant; this is inconsistent with the findings of Childs, Finnie & Martinello (2017), Delen (2010).

In my second specification, I interact sex and other explanatory variables. Sex and citizenship as well as sex and differences in financial costs in first year interaction terms are both statistically significant, which implies that the citizenship of citizen reduces the retention of females more than it reduces the retention of males, and

higher financial costs differences in the first year reduces the retention of females less than it reduces the retention of males.

In my third specification, I interact financial costs differences and other explanatory variables. Differences in financial costs in first year and admission average as well as sex and differences in financial costs in first year interaction terms are statistically significant, which implies a higher admission average reduces the retention of the students with a higher financial costs differences less than it reduces the retention of students with a lower financial costs differences.

The VIF test indicates the multicollnearity problem. If VIF is greater than 10, then there exists multicollnearity problem. The results in Table 7 show that there is no multicollnearity problem for the baseline specification. Table 8 reports the results of Wald test. According to the results we can reject the null hypothesis that estimated coefficients of all explanatory variables are zero (p-value=0) at 1% significant level.

6.2 Second Year Retention Rate

In addition to first year retention, I also consider the second year retention in this paper. The baseline specification is the same as the first year baseline specification, except that I use the second year financial costs differences rather than the first year. As some students drop out after first year, and the students admitted in 2016 were only observed once, my sample size for second year retention is 4,157.

Table 5 reports the estimates for the LPM model for second year retention. Age, gender, admission average, the differences in financial costs, admission to the Faculty of Arts, to the Faculty of Health Sciences and to the Faculty of Social Sciences all have a statistically significantly influence on second year retention. The fact that age, sex, and admission average are key factors affecting student retention is consistent with the findings of Beattie, Laliberté & Oreopoulos (2016), Hu & John (2001), Leppel (2002), Singell (2004), Angrist, Lang & Oreopoulos (2009), Bean (1980), Childs, Finnie & Martinello (2017), Wohlgemuth *et al* (2007), Delen (2010).

Although similar, the results are nonetheless somewhat different than for first year retention. The estimated coefficient for age is -.01189, which means that a 21-year-old student is 1.19 percentage points less likely to remain at uOttawa than is a 20-year-old student. The sign of the coefficient estimate of sex is negative: a male student is 2.85 percentage points less likely to persist than is a female student. However, the result for the admission average is quite different: the estimated coefficient is statistically significant, and an increase of 1 unit in the admission average increases the probability of retention by 0.48 percentage points. An increase of $1000 in the financial costs differences in the second year decreases the probability of retention by 5.44 percentage points. A student admitted to the Faculty of Arts, the Faculty of Health Sciences or the Faculty of Social Sciences is 10.08 percentage points, 7.23 percentage points and 4.85 percentage points respectively less likely to persist.

In my second specification, I interact sex and other explanatory variables. Unlike first year retention, all the interaction terms are not statistically significant.

In my third specification, I interact the financial costs differences and the other explanatory variables. The age and differences in financial costs in second year interaction term is positive and statistically significant, which implies that older students are less sensitive to financial costs differences than are younger student.

The results in Table 7 show that there is no multicollnearity problem for the baseline specification. Table 8 reports the results of Wald test. According to the results we can reject the null hypothesis that estimated coefficients of all explanatory variables are zero (p-value=0) at 1% significant level.

6.3 Determinants of Academic Performance: CGPA

Table 6 shows the OLS results when first-year CGPA (CGPA1YR) is the dependent variable. Admission average, program language, citizenship, the differences in financial costs in the first year, the square term of differences in financial costs, and admission to the Faculty of Law, the Telfer School of Management, the Faculty of Science and the Faculty of Social Sciences are statistically significant. The program

language is English, difference in financial cost, students admitted to the Faculty of Law, to the Telfer School of Management, to the Faculty of Science and to the Faculty of Social Sciences have lower CGPA; the admission average and Canadian citizenship have positive impact on CGPA. The significance of squared term of the differences in financial costs suggests that there exists a non-linear relationship between CGPA and the differences in financial costs. For the VIF test, Table 7 indicates that there is no multicollnearity problem for the regression.

6.4 Robustness Check: Comparison with Probit Estimates

The R-squared reported in Table 4 and Table 5 are small (0.0224 and 0.0376 respectively). A low R-squared does not imply that the regression is wrong and useless, and whether or not the model is appropriate does not depend directly on R-squared (Wooldridge (2012)).

However, as a robustness check, I estimated the baseline specification using a Probit procedure. The results are reported in Table 9 and Table 10. Column (3) in Table 9

and Table 10 reproduce the results of the baseline specification for the first year retention and the second year retention regressed in LPM previously reported in Table 4 and Table 5.

From the results in Table 9 and Table 10, I can see that, for the first year retention, the coefficient estimates and average marginal effect of age, sex, citizenship, differences in financial costs, the student admitted to the Faculty of Arts and the Faculty of Social Sciences are statistically significant in the Probit model, which is consistent with the result in LPM; while for the second year retention, the estimated coefficients and average marginal effect of age, sex, admission average in CEGEP, differences in financial costs, the student admitted to the Faculty of Arts, the Faculty of Health Sciences and the Faculty of Social Sciences are statistically significant in the Probit model, and the result is consistent with the result from the LPM as well.

6.5 Robustness Check: LOCAL and FINANCIAL

As a second robustness check, I substitute local variable for differences in financial

costs variable in the baseline specification of the LPM model for first year retention and second year retention.

Table 11 reports the results. Local variable is statistically significant at the 1% significance level as in financial costs differences in first and second year, and the estimated coefficient is .06939 for first year and .08579 for second year. A local student is therefore 6.94 percentage points more likely to persist than is a non-local student in the first year, and a local student is 8.58 percentage points more likely to persist than is a non-local student in the second year. Column (2) and (4) report that financial costs differences in first and second year are statistically significant at 1% significance level, and the estimated coefficient for financial costs differences in first year is -.0000279, for financial costs differences in second year is -.0000544. From the evidences above, I can conclude that a decrease of $2500 in the financial costs differences has a similar effect with the retention rates in the first year as does being local; a decrease of $1600 in the financial costs differences has a similar effect to being local on retention rates in the second year.

Difference in the set of significant explanatory variables may be suggestive of whether it is appropriate to interpret the financial costs differences in first and second year variables as actually measuring the impact of the differences in financial costs versus simply being non-local, and the appropriate interpretation of the financial costs differences in first and second year variables is that it measures the effect of differences in financial costs, and we cannot disentangle these two effects because of multicollinearity.

7. Conclusion

This paper investigates the factors that affect the retention rates for CEGEP students after the first and second year of undergraduate education. The study uses administrative data extracted by the Office of the Registrar at the University of Ottawa. There are no other studies which have looked at retention rates for out-of-province students in Canada, or which have highlighted the role of financial costs differences. The results show that age, sex, the differences in financial costs, and the faculty to which the student is admitted of are crucial factors that affect retention

in the first year and the second year; all of these factors have a negative effect. Surprisingly, I find that the admission average from CEGEP has positive effect on second year retention but does not affect first year retention, which is unusual since admission average is generally considered a key factor influence on first year academic performance, which in turn affects first year retention. Canadian citizenship negatively affects first year retention, but does not affect retention in the second year. I also find that admission to the Faculty of Health Sciences has a negative influence on second year retention but not first year retention.

The evidence suggests that the University of Ottawa should pay more attention to the age and sex of the CEGEP students, and make strategies to diminish the differences in financial costs, which includes tuition fees, accommodation costs and scholarships for different regions. The result also suggests that the university should tailor its strategy is the different faculties, especially the Faculty of Arts and the Faculty of Social Sciences.

Limitation of this study is that it did not distinguish between students admitted after over one year of CEGEP and those admitted after two years of CEGEP. Also, it did not include detailed information regarding the permanent address, and therefore may have underestimated the costs differences for students whose permanent address is in a community in which they could choose to live at home while studying at university. It would also have been useful to distinguish between programs which have limited enrollment in Quebec and those which do not.

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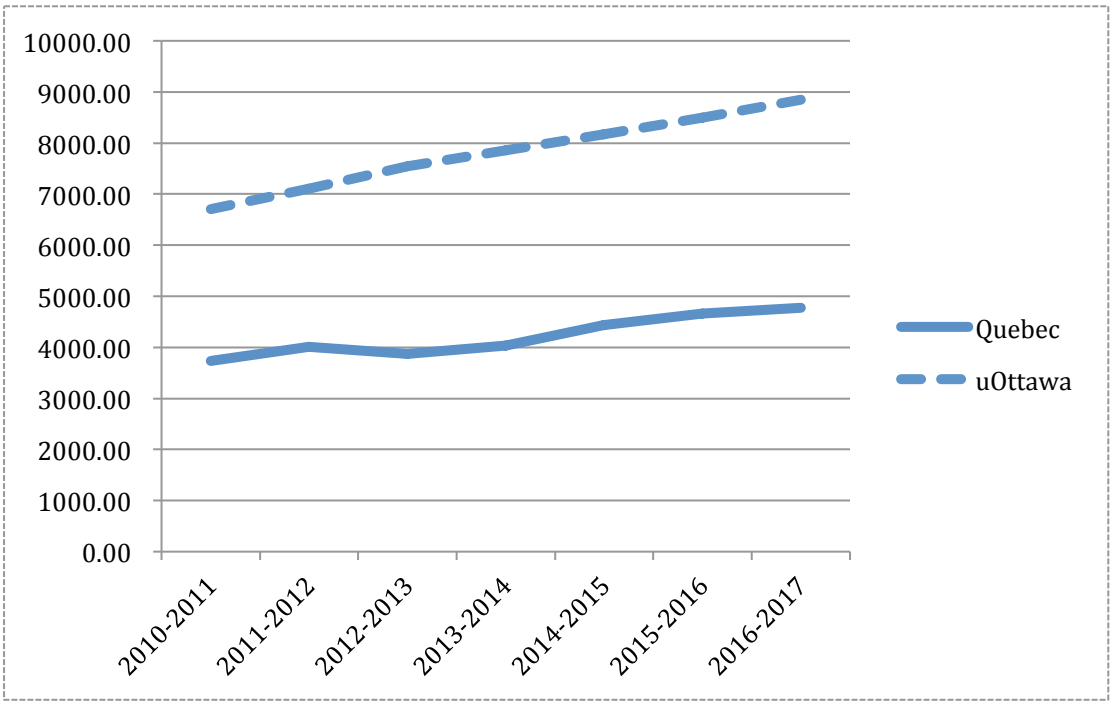
Appendix - Tables and Figures

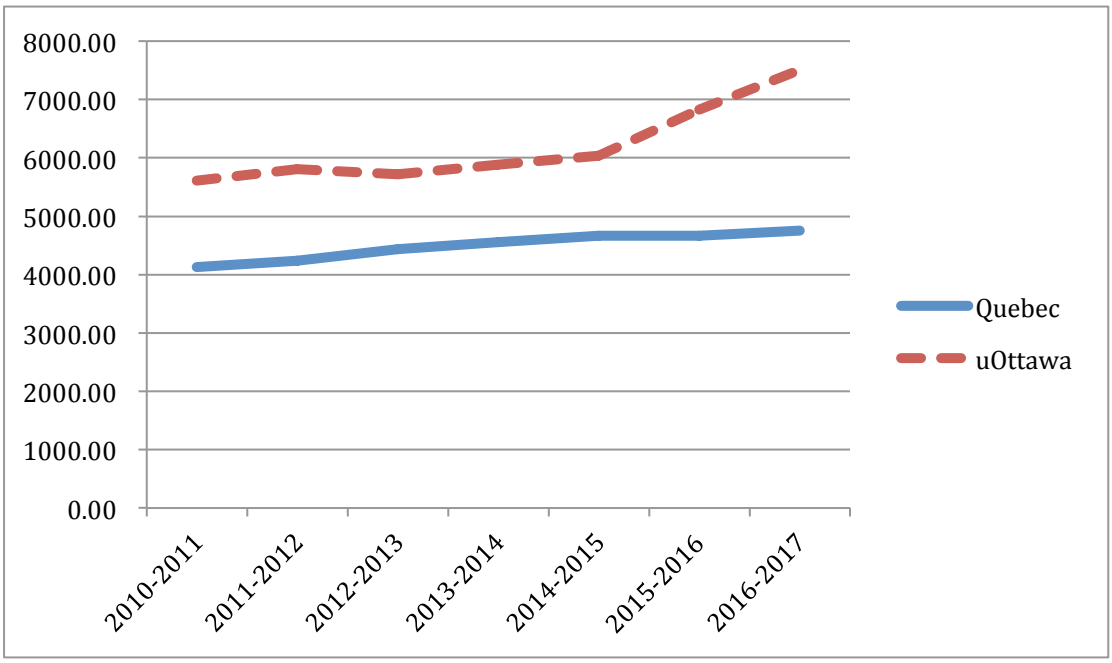
Figure 1 University Tuition Fees For Full-Time Undergraduate Canadian Students



Source:

http://odesidownload.scholarsportal.info.proxy.bib.uottawa.ca/documentation/TLAC/tlac9310-tables.html

Figure 2 Living Accommodation Costs At Residences (Room Only)



Source:

http://odesidownload.scholarsportal.info.proxy.bib.uottawa.ca/documentation/TLAC/tlac9310-tables.html

Table 1 Definitions

Variables	Definition
Dependent Variables	
First Year Retention	The individual remained in the program after the first year.
Second Year Retention	The individual remained in the program after the second year.
Independent Variables	
Age	Age at admission
Sex	The student is male.
Admission Average	Admission average in CEGEP
Scholarship Average	The best five courses average in CEGEP
CGPA	Cumulative grade point average after first year in university
Local	Students that come from the Outaouais region.
Program Language	Program language is English.
Citizenship	The student is Canadian citizen.
Permanent Resident	The student is permanent resident.
Cohort2010	The student admitted in 2010.
Cohort2011	The student admitted in 2011.
Cohort2012	The student admitted in 2012.
Cohort2013	The student admitted in 2013.
Cohort2014	The student admitted in 2014.
Cohort2015	The student admitted in 2015.
Cohort2016	The student admitted in 2016.
Arts	The student admitted in the Faculty of Arts.
Dciv	The student admitted in the Faculty of Low.
Genie	The student admitted in the Faculty of Engineering.
Gest	The student admitted in the Telfer School of Management.
Scien	The student admitted in the Faculty of Science.
Ssan	The student admitted in the Faculty of Health Sciences.
Ssoc	The student admitted in the Faculty of Social Sciences.
Financial1	Financial costs differences variable in the first year
Financial2	Financial costs differences variable in the second year

Table 2 Descriptive Statistics - Full Data Set (2010-2016)

Variables	Obs.	Mean	Std. Dev.	Min	Max	All University
Dependent Variables						
First Year Retention	4,814	.82489	.38010	0	1	87.2% (2014)
Second Year Retention	4,203	.75042	.43282	0	1	
Independent Variables						
Age	4,814	20.02243	2.82084	16	58	
Sex	4,814	.34607	.47577	0	1	39.74% (Fall 2015)
Admission Average	4,753	76.42378	6.83306	60	97.2	86.3 (Fall 2015)
Scholarship Average	4,021	83.11929	6.63168	59.2	99.7	
CGPA	3,926	6.56897	1.79438	.13	10	
Local	4,814	.48920	.49994	0	1	
Program Language	4,814	.30307	.45963	0	1	
Citizenship	4,814	.97466	.15718	0	1	
Permanent Resident	4,814	.02514	.15655	0	1	
Cohort2010	4,814	.152472	.35952	0	1	
Cohort2011	4,814	.13648	.34333	0	1	
Cohort2012	4,814	.15019	.35729	0	1	
Cohort2013	4,814	.14977	.35688	0	1	
Cohort2014	4,814	.13689	.34377	0	1	
Cohort2015	4,814	.14728	.35442	0	1	
Cohort2016	4,814	.12692	.33292	0	1	
Arts	4,814	.15476	.36171	0	1	
Dciv	4,814	.03303	.17873	0	1	
Genie	4,814	.06336	.24363	0	1	

Gest	4,814	.11944	.32434	0	1
Scien	4,814	.08351	.27667	0	1
Ssan	4,814	.12360	.32916	0	1
Ssoc	4,814	.42231	.49398	0	1
Financial1	4,814	2671.926	1794.461	-2022.62	6815.18
Financial2	4,814	3874.46	1173.775	1977.38	6815.18

Notes: The last column shows the sample of the university as a whole when the binary variable is equal to 1. Source of the last column:

https://www.uottawa.ca/institutional-research-planning/resources/facts-figures/cudo/2016-menu

Table 3 Correlation Coefficients

Correlation Coefficients	Local	Admission Average	Financial1	Financial2
Local	1.0000			
Admission Average	0.0595	1.0000		
Financial1	-0.5258	-0.3856	1.0000	
Financial2	-0.7453	-0.0616	0.7913	1.0000

Table 4 First Year Retention

Variables	(1)	(2)	(3)
Age	-.0066777***	-.0075659***	-.0132657***
	(.0023452)	(.0028643)	(.0049079)
Sex	-.0223775*	-.1284046	.0096185
	(.0124886)	(.2177484)	(.0204265)
Admission Average	.0007385	.0009794	-.001783
	(.0010493)	(.0012066)	(.0014642)
Program Language	-.0094105	-.0093873	.0061137
	(.0140085)	(.0171393)	(.0231526)
Citizenship	-.0734123**	-.122418***	.0405502
	(.0326395)	(.0317165)	(.0820144)
Financial1	-.0000279***	-.0000234***	-.0001072*
	(5.18e-06)	(5.55e-06)	(.0000574)
Arts	-.0681394***	-.0660435**	-.0628975**
	(.0257811)	(.0260825)	(.0258343)
Dciv	-.0530384	-.0519427	-.0471575
	(.0349514)	(.034989)	(.035019)
Gest	-.0100527	-.0064345	-.0030498
	(.025178)	(.02538)	(.0251831)
Scien	-.0198977	-.0205197	-.017846
	(.0264485)	(.0265139)	(.0264669)
Ssan	-.0013843	.0011937	.0001187
	(.0254713)	(.0256716)	(.025535)
Ssoc	-.0387219*	-.0376154*	-.0349922
	(.022607)	(.0228523)	(.0226558)
Sex and Age		.002736	
Interaction Term		(.0049771)	
Sex and Admission		-.0005969	
Average Interaction		(.0019644)	
Term			
Sex and Program		.0048809	

Language		(.0275029)	
Interaction Term			
Sex and Citizenship		.1359928*	
Interaction Term		(.0772707)	
Sex and Financial1		-.000014*	-.000012*
Interaction Term		(7.97e-06)	(6.83e-06)
Age and Financial1			2.21e-06
Interaction Term			(1.52e-06)
Admission Average			9.37e-07**
and Financial1			(4.76e-07)
Interaction Term			
Program Language			-3.73e-06
and Financial1			(6.79e-06)
Interaction Term			
Citizenship and			-.0000343
Financial1			(.0000219)
Interaction Term			
Cohort2011	.0259337	.0262091	.0279051
	(.0200448)	(.0200609)	(.0200485)
Cohort2012	.0301321	.0310242	.0331593
	(.0205467)	(.0205683)	(.0206267)
Cohort2013	.0507787**	.0513725***	.0529057***
	(.0199966)	(.0199806)	(.0200619)
Cohort2014	.0381632	.0373966	.0432199*
	(.0234041)	(.0234296)	(.0234941)
Cohort2015	.0665743***	.0664044***	.0714734***
	(.0246518)	(.0246698)	(.0246576)
Cohort2016	.0852045***	.0851282***	.0920525***
	(.0277973)	(.0278222)	(.0278415)
N	4,753	4,753	4,753
R-squared	0.0224	0.0240	0.0250

Notes: Column (1) is the baseline specification. Column (2) is the specification includes sex_age, sex_admavg, sex_lan, sex_citizen, sex_finan1 interaction terms. Column (3) is the specification

includes finan1_age, finan1_admavg, finan1_lan, finan1_citizen, sex_finan1 interaction terms. *significant at 10% level. **significant at 5% level. ***significant at 1% level.

Table 5 Second Year Retention

Variables	(1)	(2)	(3)
Age	-.0118952***	-.0121163***	-.0412105***
	(.0027027)	(.0031882)	(.0086208)
Sex	-.0285327*	-.009492	-.0138969
	(.0151006)	(.2457427)	(.0524174)
Admission Average	.0048461***	.0053833***	.0000985
	(.0010392)	(.0012416)	(.0037313)
Program Language	.0198872	.0368002*	.0126259
	(.0174428)	(.021363)	(.0661613)
Citizenship	-.0523099	-.0879222*	-.0132787
	(.0421801)	(.048719)	(.1446619)
Financial2	-.0000544***	-.0000552***	-.0003136***
	(8.41e-06)	(9.77e-06)	(.0001075)
Arts	-.1007554***	-.1042145***	-.0988015***
	(.0307728)	(.0309904)	(.0309849)
Dciv	.0226405	.0195147	.0232753
	(.0399849)	(.0401189)	(.0400771)
Gest	-.0125746	-.0157409	-.0089182
	(.0306949)	(.0310159)	(.0309407)
Scien	-.0470437	-.0509913	-.0466515
	(.0322903)	(.0323458)	(.0323892)
Ssan	-.0723129**	-.0742821**	-.0716783**
	(.0317729)	(.0318924)	(.0319481)
Ssoc	-.0484651*	-.0522071*	-.0480329*
	(.0272958)	(.0274228)	(.0274188)
Sex and Age		.0005717	
Interaction Term		(.0058805)	
Sex and Admission		-.0015421	
Average Interaction		(.0021036)	
Term			
Sex and Program		-.0445616	

Language Interaction		(.0349237)	
Term			
Sex and Citizenship		.0918856	
Interaction Term		(.0931503)	
Sex and Financial2		2.95e-06	-4.39e-06
Interaction Term		(.0000159)	(.0000141)
Age and Financial2			8.41e-06***
Interaction Term			(2.53e-06)
Admission Average			1.29e-06
and Financial2			(1.01e-06)
Interaction Term			
Program Language			2.10e-06
and Financial2			(.000016)
Interaction Term			
Citizenship and			-6.12e-06
Financial2			(.0000368)
Interaction Term			
Cohort2011	.0132909	.012764	.0147255
	(.0225989)	(.0225952)	(.0225459)
Cohort2012	.0414348*	.0408707*	.0420531*
	(.0228383)	(.0228159)	(.0228246)
Cohort2013	.0563171**	.0557147**	.0573338**
	(.022962)	(.0229533)	(.0229656)
Cohort2014	.0386971	.0370928	.0390978*
	(.0236418)	(.0236673)	(.0236297)
Cohort2015	.0112559	.0105562	.0097853
	(.0257188)	(.0257144)	(.0257072)
N	4,157	4,157	4,157
R-squared	0.0376	0.0385	0.0407

Notes: Column (1) is the baseline specification. Column (2) is the specification includes sex_age, sex_admavg, sex_lan, sex_citizen, sex_finan2 interaction terms. Column (3) is the specification includes finan2_age, finan2_admavg, finan2_lan, finan2_citizen, sex_finan2 interaction terms. *significant at 10% level. **significant at 5% level. ***significant at 1% level.

Table 6 Academic Performance - CGPA

Variables	Coef.
Age	.0107637
	(.0092469)
Sex	.0320696
	(.0528953)
Admission Average	.1183354***
	(.0048957)
Program Language	-.9431312***
	(.0602041)
Citizenship	.3660389**
	(.1509274)
Financial1	-.0002578***
	(.0000403)
Square Term of	1.89e-08***
Financial1	(7.17e-09)
Arts	-.1328063
	(.123805)
Dciv	-1.985762***
	(.1762328)
Gest	-.5009891***
	(.1216681)
Scien	-.56076***
	(.1359393)
Ssan	.108769
	(.1250654)
Ssoc	-.3797862***
	(.1153189)
Cohort2011	-.0669879
	(.0807308)
Cohort2012	.0257079
	(.0820376)

Cohort2013	.2237985***
	(.082738)
Cohort2014	.3613024***
	(.096748)
Cohort2015	.5584913***
	(.0992414)
N	3,883

*significant at 10% level. **significant at 5% level. ***significant at 1% level.

Table 7 VIF Test

VIF	(1)	(2)	(3)
Age	1.08	1.09	1.08
Sex	1.14	1.15	1.15
Admission Average	1.69	1.20	1.84
Program Language	1.33	1.40	1.36
Citizenship	1.03	1.03	1.04
Financial1	2.88		8.72
Square Term of Financial1			7.30
Financial2		1.67	
Arts	3.14	3.25	3.18
Dciv	1.56	1.57	1.56
Gest	2.62	2.56	2.53
Scien	2.18	2.21	2.16
Ssan	2.84	2.89	2.88
Ssoc	4.90	4.98	4.84
Cohort2011	1.65	1.60	1.61
Cohort2012	1.76	1.71	1.77
Cohort2013	1.77	1.78	1.77
Cohort2014	2.05	1.70	2.14
Cohort2015	2.36	1.95	2.54
Cohort2016	2.70		
Mean VIF	2.15	1.98	2.75

Notes: Column (1) is the baseline specification for the first year retention regressed in LPM. Column (2) is the baseline specification for the second year retention regressed in LPM. Column (3) is the specification that CGPA as dependent variable.

Table 8 Wald Test

	(1)	(2)
F(#, N)	6.02	9.96
Prob > F	0.0000	0.0000

Notes: Column (1) is the baseline specification for the first year retention regressed in LPM. Column (2) is the baseline specification for the second year retention regressed in LPM.

Table 9 Probit Estimates – First Year Retention

	(1)	(2)	(3)
Age	-.0241838***	-.0060478***	-.0066777***
	(.0073721)	(.0018392)	(.0023452)
Sex	-.0907902*	-.0227043*	-.0223775*
	(.0482554)	(.0120591)	(.0124886)
Admission Average	.0029545	.0007389	.0007385
	(.0041092)	(.0010276)	(.0010493)
Program Language	-.0259852	-.0064982	-.0094105
	(.0536177)	(.013408)	(.0140085)
Citizenship	-.2989171**	-.0747516**	-.0734123**
	(.149986)	(.0374841)	(.0326395)
Financial1	-.0001147***	-.0000287***	-.0000279***
	(.0000206)	(5.14e-06)	(5.18e-06)
Arts	-.2830828***	-.0707918***	-.0681394***
	(.1093597)	(.0273129)	(.0257811)
Dciv	-.2217323	-.0554496	-.0530384
	(.1578997)	(.0394754)	(.0349514)
Gest	-.0506207	-.012659	-.0100527
	(.1127286)	(.0281897)	(.025178)
Scien	-.0949087	-.0237342	-.0198977
	(.1215735)	(.0303977)	(.0264485)
Ssan	-.0126281	-.003158	-.0013843
	(.1172227)	(.0293141)	(.0254713)
Ssoc	-.1675041*	-.0418885*	-.0387219*
	(.1018074)	(.025447)	(.022607)
Cohort2011	.1046555	.0261717	.0259337
	(.0812641)	(.0203164)	(.0200448)
Cohort2012	.1200327	.0300171	.0301321
	(.0799767)	(.0199929)	(.0205467)
Cohort2013	.204029**	.0510225**	.0507787**
	(.0813705)	(.0203288)	(.0199966)

Cohort2014	.1597533*	.0399503*	.0381632
	(.0891325)	(.0222767)	(.0234041)
Cohort2015	.2704131***	.0676235***	.0665743***
	(.0938788)	(.023446)	(.0246518)
Cohort2016	.3555494***	.0889139***	.0852045***
	(.1073499)	(.026797)	(.0277973)
N	4,753	4,753	4,753

Notes: Column (1) is the baseline specification for the first year retention regressed in probit model. Column (2) is the average marginal effect for the first year retention. Column (3) is the baseline specification for the first year retention regressed in LPM. *significant at 10% level. **significant at 5% level. ***significant at 1% level.

Table 10 Probit Estimates – Second Year Retention

	(1)	(2)	(3)
Age	-.034228***	-.0104519***	-.0118952***
	(.0074434)	(.0022564)	(.0027027)
Sex	-.0947252**	-.0289254**	-.0285327*
	(.0479661)	(.0146297)	(.0151006)
Admission Average	.016171***	.004938***	.0048461***
	(.0034923)	(.0010598)	(.0010392)
Program Language	.0664076	.0202783	.0198872
	(.0547263)	(.0167023)	(.0174428)
Citizenship	-.1611032	-.0491947	-.0523099
	(.1348358)	(.0411572)	(.0421801)
Financial2	-.0001783***	-.0000544***	-.0000544***
	(.0000267)	(8.05e-06)	(8.41e-06)
Arts	-.3431728***	-.1047918***	-.1007554***
	(.1096883)	(.033401)	(.0307728)
Dciv	.107389	.0327925	.0226405
	(.1702088)	(.0519696)	(.0399849)
Gest	-.0535878	-.0163637	-.0125746
	(.1146399)	(.0350052)	(.0306949)
Scien	-.1698359	-.0518614	-.0470437
	(.120653)	(.0368229)	(.0322903)
Ssan	-.2627917**	-.0802465**	-.0723129**
	(.1147875)	(.0350021)	(.0317729)
Ssoc	-.1762924*	-.0538329*	-.0484651*
	(.1024944)	(.0312743)	(.0272958)
Cohort2011	.0415459	.0126865	.0132909
	(.0750793)	(.0229245)	(.0225989)
Cohort2012	.1332836*	.0406997*	.0414348*
	(.0746327)	(.0227685)	(.0228383)
Cohort2013	.181689**	.0554808**	.0563171**
	(.0763022)	(.0232611)	(.022962)

Cohort2014	.1237503	.0377886	.0386971
	(.0776459)	(.023692)	(.0236418)
Cohort2015	.0462463	.0141218	.0112559
	(.0796222)	(.0243119)	(.0257188)
N	4,157	4,157	4,157

Notes: Column (1) is the baseline specification for the second year retention regressed in probit model. Column (2) is the average marginal effect for the second year retention. Column (3) is the baseline specification for the second year retention regressed in LPM. *significant at 10% level. **significant at 5% level. ***significant at 1% level.

Table 11 Robustness Test: Local Versus Financial

	(1)	(2)	(3)	(4)
Age	-.0062936***	-.0066777***	-.0116246***	-.0118952***
	(.0023268)	(.0023452)	(.0027027)	(.0027027)
Sex	-.0243838*	-.0223775*	-.0284955*	-.0285327*
	(.0124944)	(.0124886)	(.0151032)	(.0151006)
Admission	.0035541***	.0007385	.0055753***	.0048461***
Average	(.0008606)	(.0010493)	(.0010283)	(.0010392)
Program	-.0337725***	-.0094105	-.0247597*	.0198872
Language	(.0127562)	(.0140085)	(.0152572)	(.0174428)
Citizenship	-.0689431**	-.0734123**	-.0508316	-.0523099
	(.0324953)	(.0326395)	(.0420038)	(.0421801)
Local	.0693926***		.0857957***	
	(.011139)		(.0135658)	
Financial1		-.0000279***		
		(5.18e-06)		
Financial2				-.0000544***
				(8.41e-06)
Arts	-.0622256**	-.0681394***	-.0991388***	-.1007554***
	(.0257589)	(.0257811)	(.0308555)	(.0307728)
Dciv	-.0327956	-.0530384	.0115657	.0226405
	(.0352693)	(.0349514)	(.0400189)	(.0399849)
Gest	-.0188767	-.0100527	-.0146998	-.0125746
	(.0263225)	(.025178)	(.0307551)	(.0306949)
Scien	.0021031	-.0198977	-.049322	-.0470437
	(.0253887)	(.0264485)	(.0323286)	(.0322903)
Ssan	-.0318065	-.0013843	-.0676429**	-.0723129**
	(.0226967)	(.0254713)	(.031868)	(.0317729)
Ssoc	-.0188767	-.0387219*	-.0485789*	-.0484651*
	(.0263225)	(.022607)	(.0273566)	(.0272958)
Cohort2011	.0169889	.0259337	.0086885	.0132909
	(.0199067)	(.0200448)	(.0226)	(.0225989)

Cohort2012	.0046174	.0301321	.0075909	.0414348*
	(.019774)	(.0205467)	(.0220542)	(.0228383)
Cohort2013	.0271579	.0507787**	.0137494	.0563171**
	(.0192998)	(.0199966)	(.0219816)	(.022962)
Cohort2014	-.0167277	.0381632	.0005254	.0386971
	(.0208237)	(.0234041)	(.0229588)	(.0236418)
Cohort2015	-.0028072	.0665743***	-.0544336**	.0112559
	(.020378)	(.0246518)	(.0233935)	(.0257188)
Cohort2016	-.0050765	.0852045***		
	(.0210672)	(.0277973)		
N	4,753	4,753	4,157	4,157

Notes: Column (1) is the baseline specification replacing FINANCIAL1 with LOCAL for the first year retention. Column (2) is the baseline specification for the first year retention regressed in LPM. Column (3) is the baseline specification replacing FINANCIAL2 with LOCAL for the second year retention. Column (4) is the baseline specification for the second year retention regressed in LPM. *significant at 10% level. **significant at 5% level. ***significant at 1% level.