Key Community's Impact on Graduation and Retention: A Propensity Score Analysis

Purpose

This study compares the retention and graduation rates among new freshmen who participate in the Key Learning Communities (Key) compared to those who do not. Additionally, this study focuses on understanding the differential impact of Key for historically underserved students by identifying a statistically and substantively significant interaction between a student's likelihood to be in Key and the treatment effect of Key on graduation and retention.

Historical Context of Key Community at Colorado State University

Colorado State University (CSU) created Key in 1998 with the intention of decreasing the graduation rate gaps across first generation, Pell recipient, and minority student status at CSU. Learning communities are a high impact activity that can increase a student's likelihood to succeed and it is hypothesized that learning community participation has a stronger positive impact for historically underserved students (first generation, low income, and students of color). While Key is open to all students, the program heavily recruits under-represented students and students with lower levels of academic preparation and is presented to students as an honorary experience. The goals of Key are to increase academic performance of participants; increase retention and graduation rates; foster active engagement and campus involvement amongst students; and create a sense of community and satisfaction amongst participants.

Data

First-time, full-time freshmen from the FA05 through FA11 cohorts are included in this study. Appendix A displays the cohort sizes across Key participation status. Key status is defined by participating in Key a student's first academic year. Over the five cohorts included in this study, Key has grown 85% and the total freshman cohort size has grown 16%. In FA10 and FA11, Key served about 8% of the total freshman cohort.

Methodology

A propensity score analysis is used to estimate the treatment effect of Key on student retention and graduation. This type of analysis is necessary because students self-select (are not randomly assigned) to participate in the Key program, which introduces statistical bias to causal interpretations of multivariate regression models. Propensity score matching allows for a comparison of demographically similar groups (Key/Non-Key) of students with the goal of understanding what the outcome would have been for a Key student if he/she had not participated in the program. To estimate this counterfactual outcome, the propensity score approach uses a logistic regression model to calculate the probability that a student will be in the Key program based on a variety of academic and demographic variables. Appendix B contains the logistic regression coefficients for the models that predicted Key participation across the four different samples used in this study. The probability of a student being in Key is his/her propensity score. The propensity score is then used to balance the dataset. This means that every Key student is matched (based on having a similar propensity score) to a similar non-Key student. The premise of this approach is that the matched non-Key students are a comparable control group to the Key students; therefore, the graduation or retention rates for these matched non-Key students are used to estimate the rates that would have been expected for a Key student if he/she had not been in Key (the counterfactual).
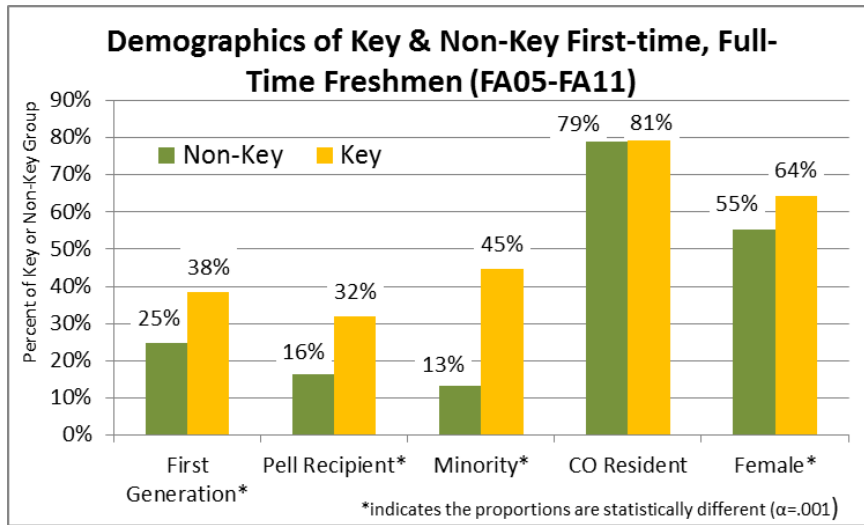
Key Population

The following section describes the demographics and academic preparation of Key students.
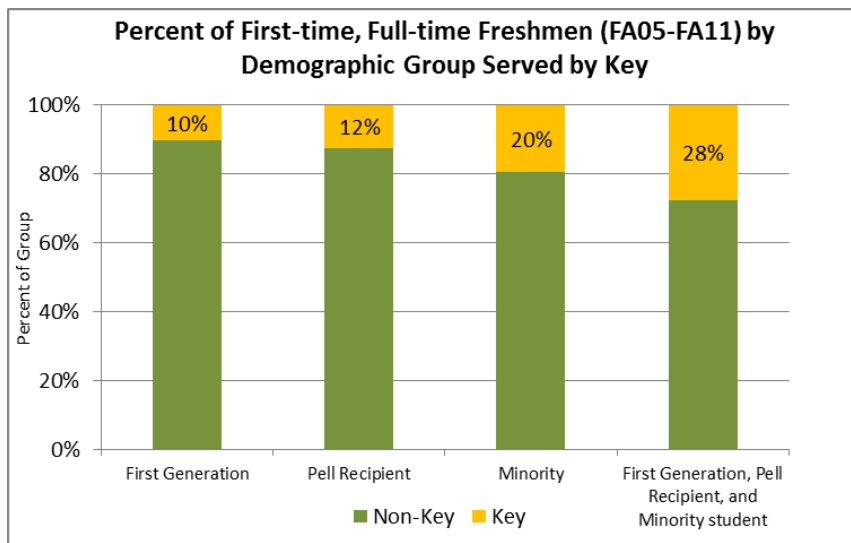
Demographics

Due to the targeted recruiting, Key participants are more likely to be first generation students, minority students, and Pell recipients. Figure 1 displays the proportions of Key and Non-Key students across first generation status, Pell recipient status, minority student status, Colorado residency, and gender for the 7 cohorts included in the study.

Figure 1.

Demographics of Key & Non-Key First-time, Full-Time Freshmen (FA05-FA11)

As shown in figure 1, there are statistically significant larger proportions of first generation, Pell recipient, minority, and female students in the Key group compared to the non-Key group. There is not a statistically significant difference in the proportion of Colorado residents across Key status. Figure 2 displays the percent of first generation, Pell recipient, and minority students who are served by the Key program. A majority of these students do not participate in Key.
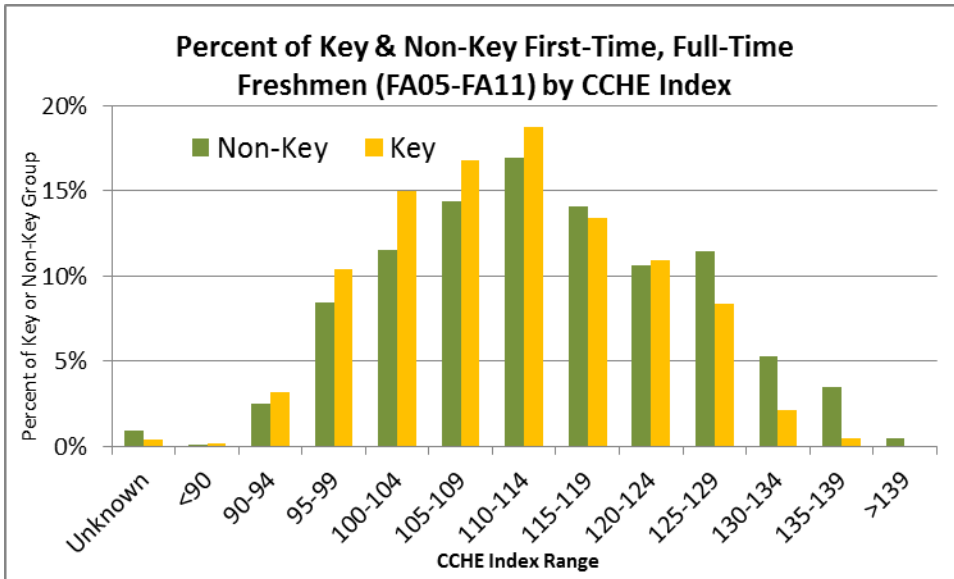
Figure 2.

Percent of First-time, Full-time Freshmen (FA05-FA11) by Demographic Group Served by Key

Academics

Academically, Key students are different from Non-Key students in terms of their high school academic performance (measured by CCHE index score) and their initial major at CSU. Figure 2 displays the index distributions by Key status.

Figure 2.

As shown in figure 2, a greater proportion of Key students have a CCHE index score (a proxy for academic preparedness) score that is below 114 and a larger proportion of non-Key students have an index of 115 or higher. Table 1 displays the average CCHE index score by Key status and the statistical comparison.

Table 1.

Statistical Comparison of Mean Index (Key/Non-Key)					
	Mean Index	Sample Size	Standard Deviation	T-statistic	P-value	Effect Size
Key	111	1991	0.22			
Non-Key	114	27113	0.07	11.25	<.001	18.4

As shown in table 1, on average Key students have a CCHE index score of 111 and non-Key students have a CCHE index score of 114. The average CCHE index score for Key students is statistically lower than the average CCHE index score for non-Key students and the magnitude of this difference is very large.

Figure 3 displays the proportion of Key and Non-Key students by students' college of major.

Figure 3.

Percent of Key & Non-Key First-Time, Full-Time Freshmen (FA05-FA11) by Cohort Major College

As evidenced in figure 3, while a large proportion of each group are undeclared (IU college), Key students are more likely to enter undeclared than non-Key students. Key students are underrepresented in the college of Engineering and Agricultural Sciences and over represented in Liberal Arts and Natural Sciences. Key students are underrepresented in the College of Engineering because comprehensive course clustering fundamental to Key's structure does not work within the prescribed curriculum of Engineering.

Expectations of Key Student Performance based on Prior Research

Prior work from Institutional Research showed a strong positive association between CCHE index score and retention/graduation. Generally, odds of graduating increase about 5% with every one point increase in CCHE index even after controlling for a variety of demographic variables. Additionally, there is a negative association between outcomes like retention/graduation and first-generation or Pell Recipient status even after controlling for academic preparation. In regards to minority status, an absolute gap exists in the retention and graduation rates between minority and nonminority students. However, the impact of minority status is eliminated once other demographic variables and academic preparation are statistically controlled. Based on this prior work and after reviewing the demographics and average index score of Key students we would predict that if they Key program had no impact then Key students would display significantly lower retention/graduation rates than the comparison group.

Observed Graduation and Retention Rates

Despite their lower index scores and larger proportions of first generation, minority and Pell recipient students, Key students have observed retention and graduation rates that are slightly better than non-key students. Table 2 displays the observed retention and graduation rates for Key and Non-Key students averaged over multiple cohorts prior to the propensity score adjustments. Appendix C displays this same information by cohort.

Table 2.

	Freshman Retention[1]	4-Year Graduation[2]	5-Year Graduation[3]	6-Year Graduation[4]
Key	88.7%	38.5%	60.8%	66.2%
Non-Key	83.2%	37.7%	59.9%	64.1%
Difference	5.5	0.8	0.8	2.1
N for Key / Non-Key	1991 / 27113	1000 / 15225	701 / 11254	408 / 7295

Unadjusted Graduation and Retention Rate Comparisons, Key Participants vs. Non-Key

[1] Includes students from FA05 through FA11 first-time, full-time cohorts

[2] Includes students from FA05 through FA08 first-time, full-time cohorts

[3] Includes students from FA05 through FA07 first-time, full-time cohorts

[4] Includes students from FA05 and FA06 first-time, full-time cohorts

As shown in table 2, Key students are retained at a rate that is 5.5 percentage points higher than non-Key students. Key students have a 6-year graduation rate that is 2 percentage points higher than non-Key students, as well as 4 and 5 year graduation rates that are very similar to non-Key students. A bivariate analysis comparing the graduation and retention rates by Key status indicates that Key students have a statistically significant higher retention rate compared to non-Key students ($\mathcal{X}^2$=44.3, p<.000), but Key graduation rates (4, 5, and 6-year) are not statistically different compared to the graduation rates of non-key students. Based on this bivariate analysis it appears Key is positively associated with retention but not associated (positively or negatively) with graduation. However, the simplicity of the bivariate approach does not account for the demographic and academic variables that are both associated with being in Key and also associated with retention/graduation so a more nuanced analysis is required.

Propensity Score Results

As discussed in the methodology section of this report, propensity scores are used to create an appropriate comparison group of non-Key students. The results presented in this section look at the average effect of Key as well as the differential impact of Key based on a student's demographics and academic preparation.

Average Treatment Effect

Using the comparison group resulting from the propensity score analysis, table 4 provides the graduation and retention rates for Key students and matched non-Key students.

Table 3.

Propensity Score Adjusted Graduation and Retention Rate Comparisons, Key Participants vs. Non-Key

	Freshman Retention	4-Year Graduation	5-Year Graduation	6-Year Graduation
Key	88.7%	38.5%	60.8%	66.2%
Non-Key	80.4%	37.1%	55.6%	56.4%
Difference (se)[1, 2]	8.3 (0.01)**	1.4 (0.02)	5.1 (0.03)*	9.8 (0.03)**
N for Key/Non-Key	1991 /1991	1000 / 1000	408 / 408	408 / 408
Additional Students Retained or Graduated	165	NA	NA	40

[1]Average treatment effect among the treated, with standard error in parentheses

[2] $*p<0.05$; $**p<0.01$

Among the balanced data set that uses propensity scores to match non-Key student to Key students, table 3 shows there is a gain of 8.3 percentage points in freshmen retention, and increases in 4, 5, and 6- year graduation estimated at 1.4 percentage points, 5.1 percentage points, and 9.8 percentage points respectively. The freshman retention, 5-year graduation, and 6-year graduation effect estimates are statistically significant.

We can apply the average treatment effects to the total number of Key students in each cohort to estimate the actual number of additional students retained or graduated because of the program. For instance, the 8.3 percentage point increase in second year retention resulted in 165 (.0829*1991) additional Key students from the FA05 to FA11 cohorts returning for their second year. Similarly, 40 (.098*408) additional students from the FA05 and FA06 cohorts graduated in 6 years because of their Key participation.

Additionally, we can use the 9.8 percentage point increase in 6 year graduation rates to estimate the impact Key has on CSU's overall graduation rate for the FA05 and FA06 cohorts. The FA05 Key cohort has 190 students; therefore, an additional 19 students (190*.098) graduated within 6 years from CSU because of their participation in the Key program. The overall FA05 cohort has 3,807 students. The 19 additional graduates increased CSU's FA05 overall rate by half of a percentage point (19/3,807). The FA06 Key cohort has 221 students, following the above logic, an additional 21 students graduated within 6 years from CSU because of their participation in the Key program. The overall FA06 cohort has 3,971 students. Key also increased CSU's FA06 overall rate by half of a percentage point.

Since each student in the adjusted dataset has a propensity (probability of the likelihood) for being in Key we can describe the group of students who are likely to be Key and the group that are unlikely to be in Key. Table 4 provides the descriptive statistics among students with the lowest and highest likelihood of being in Key.
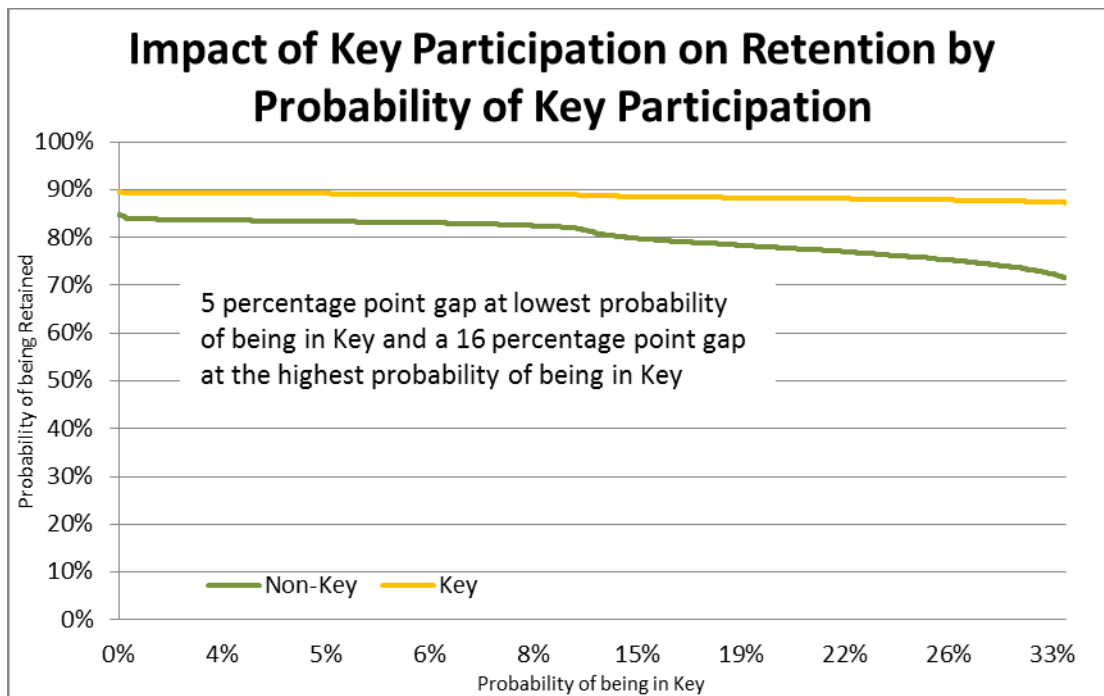
Table 4.

	Average Index	Percent First Generation	Percent Minority	Percent Pell Recipeints	Percent Female	Percent Resident	Most likely College
	Descriptive Demographics of Students by their liklihood of Particpating in Key						
Lowest likelihood of being in Key (bottom quarter)	116	11%	1%	1%	46%	76%	Intra-University (24%); Natural Sciences (19%); Liberal Arts (17%)
Highest likelihood of being in Key (top quarter)	106	67%	100%	73%	75%	87%	Intra-University (44%); Natural Sciences (22%); Liberal Arts (17%)

Students with a low likelihood of being in Key have a higher than average index (116) and aren't likely to be first generation, minority, or Pell recipients. They are also less likely to be female and slightly less likely to be a Colorado resident. In terms of major, these students are less likely to have majors in the most common colleges for new freshman. However, the students with the highest likelihood to be in Key have lower than average index scores and are very likely to be first generation, minority, and Pell recipients. These students are also more likely to be female and a Colorado resident. Thus, the students with the highest propensity to be in Key are students whose prior academic preparation and demographics typically put them at risk for attrition.

Differential Treatment Effect

The original purpose of Key is to decrease the graduation rate gaps across demographic variables. Therefore, it is also important to assess whether the treatment effect of Key varies based on a student's likelihood to be a Key participant. Figure 4 graphs the probability of being retained for Key and matched non-Key students by their likelihood to be in Key.
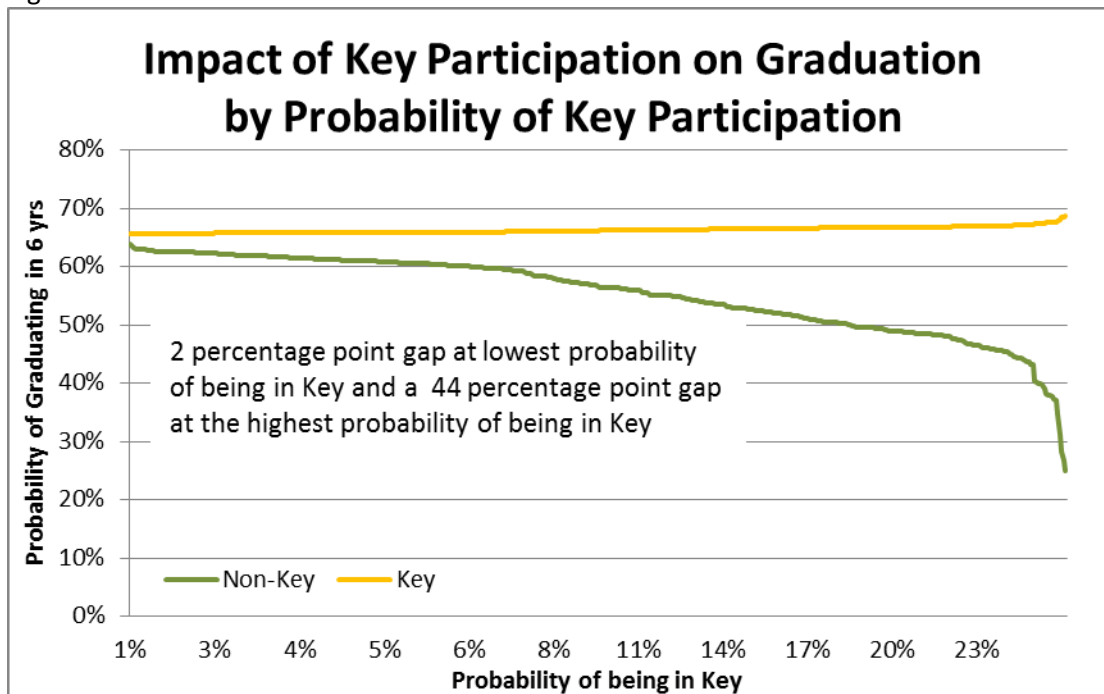
Figure 4.

The impact of the Key program is differentially higher for traditionally underserved students (those with the highest probability of being in Key). In figure 4, the x-axis shows the range of probabilities for the likelihood of being in Key while the y-axis displays the probability of freshman retention. As also shown in table 4, students with a low probability of being in Key are students with higher affinities for success based on their demographics and academic preparation. For these students the treatment effect of Key is relatively small. Participation in Key increases their probability of being retained by five percentage points. However, as a student's probability of participation in Key increases, so does the treatment effect. For a student with a high likelihood of being Key (traditionally underserved populations) there is a 16 percentage point increase in the predicted probability of being retained to the second year. Key has a positive effect on graduation for all students; however, Key has a much larger effect for students who are more likely to be in the Key program.

The effect of Key participation on graduation is also dependent on the likelihood of Key participation. Similar to the results show in Figure 5 for retention, the gap in the predicted probability of graduating within 6 years between Key and Non-Key students is smallest for students less likely to be in Key and largest for students most likely to be in Key. For instance, a Key student with a low affinity for success (higher probability for being in Key) has a similar probability of graduating as a Key student with a high affinity for success (low probability of being in Key). However, the probability of graduating for non-Key students decreases dramatically as their probability of being in the Key program increases. These results show that traditionally underserved populations benefit the most from participation in the Key program. Figure 5 graphs the probability of graduating within 6 years for Key and matched non-Key students by their likelihood to be in Key.

Figure 5.

8

Conclusions

In summary, participation in Key appears to support student success by mitigating the negative effects of lower academic preparation and at-risk attributes on graduation and retention. The following bullets highlight the major findings of this study.

- ❖ Key students are more likely than the general population to be a minority, first generation, or a Pell recipient. Additionally, Key students tend to have lower levels of academic preparation.
- ❖ However, Key does not serve all minority, first-generation, or Pell recipient students. Most of these student populations are not in Key. If funding were available, there are many students who could still benefit from participating.
- ❖ The observed retention rates for Key students are statistically higher compared to non-Key students; however, the graduation rates of Key students are very similar to non-key students. The observed rates are misleading because they do not match Key and non-Key students on demographic factors.
- ❖ Propensity scores can be used to match non-Key students to Key students in order to assess a treatment effect of Key on graduation and retention by comparing observed rates of Key students to the observed rates of the matched (demographically similar) non-key students.
- ❖ On average, participation in Key increases freshman retention rates 8.3 percentage points.
- ❖ On average, participation in Key increases the 6-year graduation rate 9.8 percentage points.
- ❖ The 9.8 percentage point impact of Key on graduation has an influence on CSU's overall 6-year graduation rate. Among the FA05 and FA06 cohorts additional Key graduates contributed a half of a percentage point to each cohorts' rate.
- ❖ The magnitude of the positive impact of Key on graduation and retention is dependent on a student's likelihood to be in Key. Key has a positive impact for all students, but Key's impact is much larger for students who are most likely to be Key.

In closing, Key has a positive effect on graduation and retention for everyone, but Key participation differentially impacts the likelihood of retention and graduation for first generation, minority, and Pell recipients or students with lower levels of academic preparation.

Appendix A.

<table>
<thead>
<tr><th colspan="9" style="text-align:center">Count of First-time, Full-time Freshman by Cohort Term</th></tr>
<tr><th></th><th>FA05</th><th>FA06</th><th>FA07</th><th>FA08</th><th>FA09</th><th>FA10</th><th>FA11</th><th>Total</th></tr>
</thead>
<tbody>
<tr><td>Non-Key</td><td>3,617</td><td>3,750</td><td>3,994</td><td>4,006</td><td>3,903</td><td>4,028</td><td>4,068</td><td>27,366</td></tr>
<tr><td>Key</td><td>190</td><td>221</td><td>294</td><td>302</td><td>300</td><td>341</td><td>351</td><td>1,999</td></tr>
<tr><td>Total</td><td>3,807</td><td>3,971</td><td>4,288</td><td>4,308</td><td>4,203</td><td>4,369</td><td>4,419</td><td>29,365</td></tr>
<tr><td>Percent of Total in Key</td><td>5%</td><td>6%</td><td>7%</td><td>7%</td><td>7%</td><td>8%</td><td>8%</td><td>7%</td></tr>
</tbody>
</table>

Appendix B.

<table>
<thead>
<tr><th colspan="5" style="text-align:center">Logistic Regression Coefficients for Key Community Participation</th></tr>
<tr><th></th><th>Retention Cohorts</th><th>4-Year Graduation Cohorts</th><th>5-Year Graduation Cohorts</th><th>6-Year Graduation Cohorts</th></tr>
<tr><th></th><th colspan="4" style="text-align:center">$b(se)$ [2]</th></tr>
</thead>
<tbody>
<tr><td>Minority</td><td>1.47(0.05)***</td><td>1.42(0.07)***</td><td>1.40(0.09)***</td><td>1.49(0.11)***</td></tr>
<tr><td>First Generation</td><td>0.20(0.05)***</td><td>0.06(0.07)</td><td>-0.02(0.09)</td><td>-0.01(0.12)</td></tr>
<tr><td>Pell Recipient</td><td>0.43(0.06)***</td><td>0.32(0.09)***</td><td>0.25(0.10)*</td><td>0.29(0.13)*</td></tr>
<tr><td>CCHE Index</td><td>-0.01(0.00)***</td><td>-0.02(0.00)***</td><td>-0.02(0.00)***</td><td>-0.02(0.01)***</td></tr>
<tr><td>CO Resident</td><td>-0.06(0.06)</td><td>-0.23(0.08)**</td><td>-0.25(0.10)*</td><td>-0.27(0.13)*</td></tr>
<tr><td>Female</td><td>0.27(0.05)***</td><td>0.44(0.07)***</td><td>0.55(0.09)***</td><td>0.68(0.12)***</td></tr>
<tr><td>College major at entry[1]</td><td></td><td></td><td></td><td></td></tr>
<tr><td>AG</td><td>-0.42(0.13)**</td><td>-0.16(0.17)</td><td>-0.15(0.21)</td><td>-0.39(0.30)</td></tr>
<tr><td>AHS</td><td>-0.25(0.08)**</td><td>-0.19(0.12)</td><td>-0.05(0.13)</td><td>-0.08(0.18)</td></tr>
<tr><td>BU</td><td>-0.02(0.10)</td><td>0.32(0.14)*</td><td>0.35(0.17)*</td><td>0.23(0.22)</td></tr>
<tr><td>EG</td><td>-2.81(0.32)***</td><td>-2.87(0.58)***</td><td>-2.32(0.59)***</td><td>-2.10(0.72)**</td></tr>
<tr><td>LA</td><td>-0.02(0.07)</td><td>0.17(0.10)</td><td>0.24(0.12)</td><td>0.22(0.16)</td></tr>
<tr><td>NS</td><td>-0.06(0.07)</td><td>0.14(0.10)</td><td>0.07(0.13)</td><td>-0.07(0.17)</td></tr>
<tr><td>VMBMS</td><td>-0.05(0.13)</td><td>0.15(0.17)</td><td>0.09(0.20)</td><td>-0.21(0.27)</td></tr>
<tr><td>WCNR</td><td>0.20(0.14)</td><td>0.72(0.18)***</td><td>0.90(0.20)***</td><td>1.17(0.24)***</td></tr>
<tr><td>Constant</td><td>-2.04(0.27)***</td><td>-1.19(0.39)**</td><td>-0.95(0.46)*</td><td>-1.41(0.60)*</td></tr>
<tr><td>N</td><td>29,104</td><td>16,225</td><td>11,955</td><td>7,703</td></tr>
<tr><td>Likelihood Ratio Chi-Squared, df = 14</td><td>1475.83</td><td>667.09</td><td>463.41</td><td>308.27</td></tr>
<tr><td>Psuedo R^2</td><td>0.102</td><td>0.0888</td><td>0.0868</td><td>0.0966</td></tr>
</tbody>
</table>

[1] Reference category is Intra-University (IU)

[2] *p ≤ .05, ** p ≤ .01, *** p ≤ .001

Appendix C.

Graduation and Retention Rates by Cohort for Key / Non-Key

	FA05	FA06	FA07	FA08	FA09	FA10	FA11
Key Retention	88.2	87.8	86.0	88.6	91.0	90.6	88.0
Non-Key Retention	82.9	82.0	82.6	83.2	84.0	82.9	84.5
Key 4-year Graduation	43.3	38.0	31.7	42.5			
Non-Key 4-year Graduation	35.6	38.0	38.0	39.0			
Key 5-year Graduation	67.4	59.3	57.7				
Non-Key 5-year Graduation	59.3	59.8	60.6				
Key 6-year Graduation	70.6	62.4					
Non-Key 6-year Graduation	64.4	63.9					