The Role of Finances on Student Success: The Overwhelming Influence of Unmet Need

DRAFT as of 10/7/2015

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with

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The Punchline

Retention vs. Unmet Need

2nd Fall Retention Rate

No FAFSA, <20k, -20k to -15k, -15k to -10k, -10k to -5k, -5k to 0k, 0k to 5k, 5k to 10k, 10k to 15k, 15k to 20k, 20k to 25k, 25k to 30k, >30k
Outline

1. Unmet Need and other Financial variables
2. Predictors of Student Success
3. Attrition Timing
4. The increasing Unmet Need burden
5. Need-based aid to improve retention
FAFSA Financial Variables

- **Adjusted Gross Income (AGI):** the student’s family income, adjusted for specific deductions.
- **Expected Family Contribution (EFC):** the Government estimate of the amount a student’s family can pay for college.
- **Gross Need:** Cost of Attendance minus Expected Family Contribution; the total amount of aid a student needs receive in order to afford college.
- **Unmet Need:** Gross Need minus total aid package; the amount of need left over after aid has been received.

### FAFSA Completion (GRS Cohort)

<table>
<thead>
<tr>
<th></th>
<th>No FAFSA</th>
<th>FAFSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2011</td>
<td>21.8%</td>
<td>78.2%</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>21.0%</td>
<td>79.0%</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>19.6%</td>
<td>80.4%</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>20.5%</td>
<td>79.5%</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>20.7%</td>
<td>79.3%</td>
</tr>
</tbody>
</table>
Retention vs. Financial Variables

- Unmet Need has by far the strongest association with Retention.
Residency

- In-state students are more strongly affected by Unmet Need than Out-of-state students.
Academic Readiness

Retention vs. Readiness Variables

- HS GPA is a better predictor than ACT
- **HS Readiness Index** combines the two to maximize predictive power
  - $\text{HSRI} = \text{HS GPA} \times 10 + \frac{\text{ACT}}{2}$
Unmet Need and HSRI

- High Unmet Need students are retained at lower rates than lower Unmet Need peers at all levels of academic readiness.
High Unmet Need students also under-perform lower Unmet Need peers in the classroom.
College Capability Index is a single variable optimally combining HSRI plus Unmet Need. 

CCI = HSRI + Unmet Need / $1000
CCI In The Wild

- CCI is ideal for program effectiveness studies.
- CCI is NOT for program selection!
  - FAFSA data can only be used for financial aid decisions
  - Post-hoc analyses are implicitly comparing programs to need based aid
First Spring Retention

- Unmet Need has a particularly strong impact on 1st Spring Retention.
First Spring to Second Fall

- Academic performance has a much stronger influence on retention behaviour after the 1st Spring term.
In general, we see a “survivor effect”, whereby Unmet Needs exerts less influence on progression and persistence for upper division students.
Unmet Need is Growing

- The number of students with high unmet need is growing rapidly.
  - The distribution of unmet need is widening (more at high and low)
Unmet Need Driving Attrition

- The increasing Unmet Need burden is likely to be leading to lower retention rates.
- We can create “what-if” models to measure the retention rate given changes to the Unmet Need distribution
  - Assumes that Unmet Need is a cause, not a symptom, of attrition.
  - Without more direct tests of causation, it is possible that Unmet Need co-varies with other hidden variables which are the true drivers of attrition.
Retention Losses from Unmet Need

- Simulate retention of Fall 2013 class, if Unmet Need matched that of Fall 2008.
  - Use rank-matching to assign a “Simulated Unmet Need” to each Fall 2013 cohort student
- Use L.R. to calculate new “simulated” retention probability for each student.
Simulation Results

- Because students with high Unmet Need have a lower “simulated” Unmet Need, their retention probability increases.
- The net effect is a 1.6% point increase in the overall retention rate.
Targeting Need-Based Aid at Retention

● If Unmet Need is driving retention losses, then need-based aid could amend this.
  ○ How much money does retention cost?
  ○ What is the most efficient way to disburse aid?

● Eliminating Unmet Need
  ○ Set all students with positive Unmet Need to 0, and re-calculated predicted retention rate

<table>
<thead>
<tr>
<th>Cohort Term</th>
<th>Actual Retention Rate</th>
<th>Predicted Change in Retention Rate</th>
<th>Cost of Eliminated Unmet Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2009</td>
<td>81.8%</td>
<td>2.4%</td>
<td>$7,270,762</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>81.5%</td>
<td>2.9%</td>
<td>$9,569,360</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>81.3%</td>
<td>3.4%</td>
<td>$10,521,664</td>
</tr>
<tr>
<td>Fall 2012</td>
<td>82.5%</td>
<td>3.5%</td>
<td>$12,619,187</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>82.2%</td>
<td>4.3%</td>
<td>$14,858,680</td>
</tr>
</tbody>
</table>
Optimizing Need-Based Aid

- If we want to maximize the impact on retention, how would we distributed Need-Based aid?
  - Simulate decreasing each student’s Unmet Need and determining the predicted effect on retention.
  - In order to find the optimal distribution of aid, we iterate:
    1. Increase the aid package of each student by $1000
    2. Find the student whose predicted retention is increased by the largest amount
    3. Apply the $1000 to the student’s simulated aid package
    4. Repeat the process, simulating starting from the new simulated aid packages.
Optimizing Need-Based Aid Results

- $1M buys about 0.5% points of retention
  - $20M buys about 6.5% points
Conclusions

1. Unmet Need is a strong driver of retention.
   a. At least as predictive as pre-college academic readiness.
   b. Particularly important for 1st semester attrition.

2. The number of students with high Unmet Need burdens is growing rapidly.

3. Shifting resources to need-based financial aid may be necessary to improve retention.
   a. Draft UK Strategic Plan: “Align institutional scholarship and financial aid awards... to minimize students' unmet financial need”.
Appendix: Supplemental Data and Statistical Results
Correlations Between Variables

- Students with low Gross Need or high EFC cannot have positive Unmet Need.
- Although all the financial variables are correlated, Unmet Need is a uniquely strong predictor of Retention.
Correlations Between Variables, cont.

- Gross Need, EFC, and AGI are all highly correlated.
- Gross Need is particularly correlated with EFC. The upper locus contains out-of-state students; in-state students fall in the lower loci.
Univariate Financial Variable Models

- Each of these models uses a single financial variable as the independent variable and 2nd Fall Retention as the dependent variable in a logistic regression analysis.

Univariate Logistic Regression Results

<table>
<thead>
<tr>
<th>Financial Variable</th>
<th>Beta</th>
<th>Odds Ratio</th>
<th>pseudo-$R^2$</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmet Need</td>
<td>-0.70</td>
<td>0.50</td>
<td>0.073</td>
<td>0.689</td>
</tr>
<tr>
<td>Gross Need</td>
<td>-0.51</td>
<td>0.60</td>
<td>0.016</td>
<td>0.601</td>
</tr>
<tr>
<td>Adjusted Gross Income</td>
<td>0.36</td>
<td>1.44</td>
<td>0.011</td>
<td>0.591</td>
</tr>
</tbody>
</table>

*Standardized
** Students without FAFSA information have been removed.
Demographics with HSRI

- HSRI is useful to see the effects of demographics
- First Generation, Appalachian County and On Campus Housing all are significantly associated with retention
Unmet Need vs. HSRI

- Unmet Need is somewhat correlated with HSRI
- Low readiness students are much more likely to have high Unmet Need than higher readiness students
  - This is likely to be due to merit-based financial aid
Summary of Logistic Regression Models

- Each model uses a different set of independent variables, with 2nd Fall Retention as the dependent variable.

<table>
<thead>
<tr>
<th>Model</th>
<th>Pseudo-R²</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmet Need</td>
<td>0.073</td>
<td>0.689</td>
</tr>
<tr>
<td>Unmet Need + Residency*</td>
<td>0.083</td>
<td>0.691</td>
</tr>
<tr>
<td>HS GPA</td>
<td>0.069</td>
<td>0.688</td>
</tr>
<tr>
<td>ACT</td>
<td>0.032</td>
<td>0.626</td>
</tr>
<tr>
<td>HS GPA + ACT (HS Readiness Index)</td>
<td>0.073</td>
<td>0.693</td>
</tr>
<tr>
<td>Unmet Need + Residency* + HS GPA + ACT</td>
<td>0.121</td>
<td>0.734</td>
</tr>
<tr>
<td>Unmet Need + Residency* + 1st Fall UK GPA</td>
<td>0.268</td>
<td>0.818</td>
</tr>
</tbody>
</table>

*Includes interaction term
### Multivariate Logistic Regressions

**HS Academics plus Unmet Need†**

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS GPA*</td>
<td>&lt;0.001</td>
<td>1.68</td>
</tr>
<tr>
<td>ACT*</td>
<td>0.059</td>
<td>1.07</td>
</tr>
<tr>
<td>Unmet Need**</td>
<td>&lt;0.001</td>
<td>0.91</td>
</tr>
<tr>
<td>Residency*** (out-of-state)</td>
<td>0.015</td>
<td>0.85</td>
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<tr>
<td>Unmet Need, Residency interaction</td>
<td>&lt;0.001</td>
<td>1.06</td>
</tr>
<tr>
<td>intercept</td>
<td>&lt;0.001</td>
<td>6.11</td>
</tr>
</tbody>
</table>

pseudo-\(R^2 = 0.121\)

AUC = 0.734

**1st Fall GPA plus Unmet Need†**

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Fall UK GPA*</td>
<td>&lt;0.001</td>
<td>3.28</td>
</tr>
<tr>
<td>Unmet Need**</td>
<td>&lt;0.001</td>
<td>0.92</td>
</tr>
<tr>
<td>Residency*** (out-of-state)</td>
<td>&lt;0.001</td>
<td>0.58</td>
</tr>
<tr>
<td>Unmet Need, Residency interaction</td>
<td>&lt;0.001</td>
<td>1.04</td>
</tr>
<tr>
<td>intercept</td>
<td>&lt;0.001</td>
<td>8.26</td>
</tr>
</tbody>
</table>

pseudo-\(R^2 = 0.268\)

AUC = 0.818

* standardization of variables
** per $1000
*** Default is in-state

† Using 2nd Fall retention as the dependent variable.