A Case Study to Examine

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Abstract

This paper considered at three selection indices to select peers. Although conceptually similar, the researchers were interested to see the differences in peers each might yield. Based on previous research, a summary of the steps leading to the deployment of the indices are provided. A detailed description on how to compute each index is also given. These steps in conjunction with the use of a selection index are in effect, a complete set of directions needed to select a set of peers.

Statistical analysis revealed that the three selection indices under investigation yield slightly different sets of peers. Moreover, the percentile index may be preferred for non-normal variables. However, the normative index works almost as well and is keen on selecting institutions that are close to the target institution when the distribution is non-normal and leans in the same direction as the target institution's position in that distribution. Pros and cons of all three index distributions are discussed.

A Case Study to Examine

Peer Grouping and Aspirant Selection

This research builds on previous work by one of the authors that examined how institutional peers are selected. For the purpose of this research, peer is defined as institutions that are similar with regard to certain delineating factors (Andres, 1999; Trainer, 2008). In that work, the proximity index (McLaughlin, Howard, & McLaughlin, 2011) was deemed to be the most appropriate methodology for the selection of a generic set of institutional peers (D'Allegro & Zhou, 2013). However, we have been approached by faculty and staff with several approaches to peer selection that were not considered in our previous paper. We thought the faculty's methodologies seemed fairly reasonable which got us thinking about our previously published paper on the selection of peers. It also seemed to reinforce the assertion that the process for determining peers seems to be arbitrary (Andres, 1999). Accordingly, there is little or no evidence to their quality or adeptness of many of these processes to select a set of peers. Our process included. We still advise that careful planning and investigation of the criteria used to select a set of institutional peers but we now realize the frailty of even the most careful of selection procedures.

At the heart of the research is the description of three different indices to select institutional peers and the comparisons among those peer sets. Those indices were derivations of the Nearest Neighbor rationale (McLaughlin, Howard, & McLaughlin, 2011). For all three indices, the distance between any given institution and the target institution on predetermined parameters were calculated. The determination of the nearest neighbors or peers varies for each index but generally, all ascertain how closely matched an institution is to the target institution.

That said, the initial set of institutional peers does not deviate from the 2013 study (D'Allegro & Zhou, 2013). Justifications to why these two indices should also be considered as viable alternatives are also given. Unresolved is the determination of the most appropriate index choice to decipher a relevant set of peers.

Method

This study does not abandon previously applied principles including the use of several sources and methods to uphold a practical balance between stakeholder judgment and statistics (Trainer, 2008). As we have learned in the eventual adoption of the set of institutional peers, credibility of the institutional peer sets very much relies on constituent input. Not only were faculty and staff consulted for this compilation, we actually acted on the preliminary logic of faculty that were selecting peers for a very specific purpose. As with all of our endeavors, selection methodology was modified based on the suggestions of colleagues and interested parties as well as informed by other documented peer selections.

Note that in the original research, we did investigate several peer sets chosen by a handful (5) of institutional characteristics. Using different combinations of those institutional characteristics, we discovered that the resulting peer sets were similar to the target institution with respect to some data elements but different on others. Those differences were perceptible to warrant the selection process unworkable. This reinforces previous findings that institutional characteristics alone are not sufficient in choosing institutional peers (Shin, 2009).

The selection process entailed several steps. These are outlined by D'Allegro & Zhou (2013). In short, the steps are: (1) choosing an initial set of peers, (2) choosing the preliminary set of variables, (3) variable transformations, (4) establishing the best set of variables to use, and (5) establishing the best selection strategy. This research is fundamentally identical to our last

study except the last step. At the crux of the research, we compared the proximity index to that of the percentile and normative indices to determine to see which emerged as the best selection index. Therefore, a brief summary of steps 1-4 are provided below with a more in-depth description of step 5. Again, for a more detailed description of the preparatory steps refer to D'Allegro and Zhou (2013).

1. Initial Peers. The initial set of peers were selected a priori to this study. To recap, the select the initial set of peers institutional characteristics were identified to reduce the number of possible peers. The initial set of institutions was chosen from an original list of private, non-profit institutions that submitted data to IPEDS from the Data Center website. The list was generated using the EZ group option (National Center for Education Statistics, 2012). Data for these institutions were collected for 2010 and 2011, the most recent data available at the time of the previous study. An updated data set was identically assembled using 2013 and 2014 information, the most recent data available at the time of this study. Note that for the target institution, the basic 2015 Carnegie Classification did not change from 2010 (Carnegie Foundation, 2015). Further, the only the 2010 Carnegie Classification is available on the EZ group option. Lists for both time periods were generated using the following criteria: (a) private not-for-profit institutions, four-year or above, (b) highest degree awarded is either a Bachelor's degree, Master's degree, or both, (c) baccalaureate College- arts & sciences or baccalaureate balanced arts & sciences- diverse fields, (d) enrolled full-time undergraduate students, (e) Institution size between 1,000 and 9,999, (f) Title IV participant (federal financial aid eligibility), (h) located in US or designated as US Service School (e.g. US Naval Academy), and (i) not a tribal college. This is on par with selection parameters recommended by previous studies (Andres, 1999) and within the parameters of the target institution. As a result of applying these

criteria, 285 institutions were selected for the previous study while the updated listed yielded 267 institutions.

2. Choosing Variables. Other relevant information was collected for each of these institutions. Relevance in the context of selecting peers are those data points that indicate the institution's priorities (Andres, 1999; Cohodes & Goodman, 2012). For the most part, an institution's focus is on quality. As such, we honed in the target institution's own Key Performance Indicators (KPIs) which is a mix of approximately 20 output or direct measures of quality and input or influencers of quality measures. Therefore, the first set of variables chosen either had some influence on quality or were direct measures of quality or performance. We also asked faculty and staff to rate the importance of each KPI mindful of the importance of using both input and output variables in the peer selection process.

Another prerequisite was that the data had to be easy to find and access for the all or most of 285 institutions. Several sources were considered including: (a) National Survey of Student Engagement (NSSE) benchmarks, (b) American Association of University Professors (AAUP) faculty salary data, (c) Noel Levitz Student Satisfaction Inventory (NLSSI), and (d) US News & World Report rankings (US News & World Report, 2011). Nevertheless, not all institutions participate in the NSSE or NLSSI or administer these surveys within a reasonable time period to avail comparisons. Detailed AAUP salary data is not available for many institutions. Consequently, data was obtained from IPEDS or the (b) US News & World Report rankings.

The preliminary set of 23 variables are shown in Appendix A along with the institutional characteristics used to select the initial set of peers. A description of each variable and institutional characteristics is given in Appendix B. Note that the KPIs have remained the same

and we did not solicit the faculty again. Therefore, no adjustments were needed for the updated data set.

3. Variable Transformations**.** There was a fair amount of variability in enrollment among the initial set of institutions. Moreover, the enrollment of the target institution was twice the size of most of the original set. Therefore, some of the data elements were standardized to mitigate difference due to institutional size (Gater, 2003; Huxley, 2009). This was accomplished by using the FTE as the divisor. Examples of data elements that were standardized by dividing by FTE include the number of conferred bachelor's degrees, number of applicants, unduplicated annual enrollment, instructional expenses, and endowment.

Full-time and part-time faculty counts were combined into one data element. In effect, the proportion of full-time faculty was calculated by dividing the sum of full-time plus part-time faculty into number of full-time faculty.

4. Best Variables to Use. Of the 23 variables identified in step 2, three were both output measures and among the target institution's KPIs: (a) ratio of conferred Bachelor's Degree to FTE, (b) one-year retention rate, and (c) six-year graduation rate. These variables were also student centered, specifically student success focused and therefore aligned with the target institution's mission. To augment the data analysis, the remaining variables were classified into one of the following five groups: (a) admissions, (b) faculty, (c) enrollment, (d) institutional characteristics, and (e) finance.

As described in our previous research, several regression analyses, single step ordinary least square (OLS), help identify the best variables to select a set of peers. In the first phase, regression models were compiled separately for the five variable categories for each of the three output measures, a total of fifteen models. Because the analysis was still exploratory at this

stage, the single step enter method was preferred over other models. Coupled with distributing the variables into five groups allowed the inclusion of all variables into the model for that category (SPSS, 2008). Informed by previous research, the regression coefficients were the determined what data elements would be used for peer selection (Hom, 2008).

In the second phase, an overall regression model for each output variable was computed using the best predictor(s) smallest significance level for the standardized beta coefficient from each of the five category regressions. The beta weight's significance level indicates if a variable is a predictor if it was included in the model compared to its absence (Cohen & Cohen, 1983). Although there were occasional exceptions, only one variable from each category was chosen for the three overall models. This was deliberate because there were high correlations among variables in any given category and it also forced a balance of institutional metrics for peer selection. The best predictors for each KPI regression model by category for the original and updated data sets are listed in Table 1.

5. Best Selection Strategy. Peer institutions are determined by having metrics that are close to the target institution (McLaughlin, Howard, & McLaughlin, 2011). This is manifested in the computation of a selection index. At the heart of this paper, three selection indices were examined: (a) proximity, (b) percentile, and (c) normative. The calculation of each index also involves several steps but the steps are basically the same for each: (a) identifying the most relevant parameters, (b) computing the numerical difference between the reference and target institution on each of those parameters, (c) averaging those differences across parameters, and (d) using percentile ranges to determine what constitutes a peer or a "almost peer" difference. The first step, the most relevant parameters, have already been decided by the three overall OLS models mentioned in step 4. Descriptions of steps 2-4 are provided below.

Proximity Index. As mentioned, the numeric difference between the target and each comparison institution are determined for the each of the nine variables. The mean of these differences determine peer proximity. For the proximity index, the unit of measure is the standard deviation for each of those nine variables. This is illustrated in in Figure 1 with the assumption that the data distribution for each of the nine variables is normally distributed. For each variable, a proximity score of 1 was assigned to any institution that was between one-half and one standard deviation of target institution's metric, a score of 2 was given if the institution was within one-half a standard deviation. Equally, weighted, the average of the nine proximity scores derive the proximity index. Although already published, it is worth restating the two equations that comprise the proximity index calculation.

$$PS_{var1}=(TI_{varx} - CI_{varx})/ SD_{varx} \quad (1)$$
$$varx \in \{1,\ldots 9\}$$

$$PI_{institution}= \text{average } (PS_{var1}\ldots PS_{var9}) \quad (2)$$
$$\text{institution} \in \{1,\ldots 285\} \text{ or institution} \in \{1,\ldots 267\}$$

Where:
PS = Proximity Score
PI = Proximity Index
TI= Target Institution
CI= Comparison Institution
Var_1-Var_9= Predictors

0 reassigned to PS when: PS > 1 or PS < -1
1 reassigned to PS when: -1< PS < -.5 or .5 < PS < 1
2 reassigned to PS when: -.5 < PS < .5

A small number of data elements relative to other studies were used to compute the proximity index, the mean score across nine predictor variables (McLaughlin, Howard, & McLaughlin, 2011). However, a large number of variables that are highly correlated make the interpretation difficult to interpret (Gater, 2003; Lorr, 1983).

Percentile Index. For the percentile index, differences between the target and each comparison institution are still determined for each of the nine variables. Moreover, the logic is the same and is shown in in Figure 1. Contrary to the proximity index, however, the boundaries for each percentile score is determined by the first and third quartile cut-scores not by the data distribution's standard deviation. In effect, the percentile index assures equal number of institutions in each partition.

As such, a slight diversion is in order. A non-normal index distribution is not assumed for the index procedures and skewed variables can still produce accurate results (Smith, 2012). Extreme values or outliers on the low side or high side of the distribution may affect or skew the distribution and drag the mean away from a true measure of central tendency. Outliers on both ends, may also effect the distribution's kurtosis (Hembree, 2013). In turn, this exaggerated dispersion may unduly increase the standard deviation and as a result, stretch the distribution segments. Consequently, a disproportional number of institutions would receive larger index scores than they deserve because they would be more likely to fall in a subdivision closer to the mean. This may not be a problem per se but could compromise the ability of the index to distinguish a peer from a non-peer.

On the other hand, the percentile index distribution is partitioned with an equal number of institutions in each. Unlike the proximity index, the percentile index is less affected by outliers as it relies on the median as the center of the distribution and not a potentially displaced mean. Therefore, the percentile index may be a potential advantage over the proximity index especially for skewed data distributions.

For each variable, a percentile score of 1 was assigned to any institution that was within 25 percentile points of a target institution's metric, a score of 2 was given if the institution was

12.5 percentile points. This is a large and generous partition given a percentile score greater than 0 is awarded if the institution is within 50 percentile points or half the distribution. Equally, weighted, the average of the nine percentile scores derive the percentile index. Nonetheless, the same two equations can be used to compute the percentile index.

$$PerS_{var1}=(TI_{varx} - CI_{varx})/ SD_{varx} \quad (3)$$
$$varx \in \{1,\ldots 9\}$$

$$PerI_{institution}= average\ (PS_{var1}\ldots PS_{var9}) \quad (4)$$
$$institution \in \{1,\ldots 285\} \text{ or } institution \in \{1,\ldots 267\}$$

Where:
PerS = Percentile Score
PerI = Percentile Index
TI= Target Institution
CI= Comparison Institution
Var_1-Var_9= Predictors

0 reassigned to PerS when: PerS > 1 or PerS < -1
1 reassigned to PerS when: -1< PerS < -.5 or .5 < PerS < 1
2 reassigned to PerS when: -.5 < PerS < .5

Normative Index. Before the boundaries for each normative were established, values for each of the nine variables were converted to a z-score. Each of the nine variables were standardized with the resulting distribution having a mean of 0 and standard deviation of 1 (SPSS, 2012). That said, the standard normal distributions were derived from using the original distribution's mean and standard deviation. Therefore, effects of the outliers and resulting asymmetrical distributions were not completely eradicated. However, the advantage of these transformed distributions is the fact that the new distributions were symmetrical. In essence, the normative index is a hybrid of the proximity and percentile indices. As with the proximity index, the mean and standard deviation determine distance or probability. However, the use of the standard normal distribution as with the percentile index ensures that the distribution is sectioned into equal parts.

Another benefit of transforming the original distribution to the standard normal distribution is that the cut-points are easier to compute and conceptualize. As mentioned, the curve created by the z-scores, x-axis, and resulting probabilities, y-axis, in a standard normal distribution is symmetrical (Weiss, 2015). The area under the curve to the left of the z-score vis a vis the proportion of the area under the curve to the left of the z-score was used to determine distance to the target institution. The total area under the curve or total probability is one.

For each variable, a normative score of 1 was assigned to any institution that was within the one-fourth the distance of the total standard normal distribution's area from the target institution. A score of 2 was given if the institution was within one-eighth of the area or distance from the target institution's z-score probability. Equally weighted, the average of the nine normative scores derive the normative index. The same two equations used for the other two indices can be also used to compute the normative index.

$$NorS_{var1}=(TI_{varx} - CI_{varx})/ SD_{varx} \quad (5)$$
$$varx \in \{1,\ldots 9\}$$

$$NorI_{institution}= \text{average } (PS_{var1}\ldots PS_{var9}) \quad (6)$$
$$\text{institution} \in \{1,\ldots 285\} \text{ or institution} \in \{1,\ldots 267\}$$

Where:
NorS = Normative Score
NorI = Normative Index
TI= Target Institution
CI= Comparison Institution
Var_1-Var_9= Predictors

0 reassigned to NorS when: NorS > 1 or NorS < -1
1 reassigned to NorS when: -1< NorS < -.5 or .5 < NorS < 1
2 reassigned to NorS when: -.5 < NorS < .5

Results

Proximity Index. For the original data, the range of the resulting proximity indices was 1.33 to 1.78 for the peers and almost peers. The updated data set posted a range between xx and 1.xx for

the peers and almost peers. Taking into account, the range of proximity indices and the resulting percentiles for these institutions, two peer sets emerged. Peers comprised the 19 institutions having proximity indices corresponding to the 95th percentile or higher. Another 19 institutions constituted the next tier of peer institutions, dubbed "almost peers." For both data sets, these "almost peers" had proximity indices between the 90th and 95th percentiles. The sets of proximity index peers for both data sets are shown in Appendix C.

As seen in Appendix C.

Percentile Index. For the original data, the percentile index range for the peers and almost peers was more compressed than the proximity index: 1.44 to 1.78 and xx to 1.xx for the updated data set. For comparative purposes, the same cutoffs used for the proximity index were also applied to the percentile index peer selection, 95th percentile or higher and between the 90th and 95th percentiles. Despite the compressed range for the original data, the peer set is slightly larger with 21 percentile index peers. Conversely, the almost peer set is smaller containing nine institutions. Curiously, the percentile index almost peer set is one-half the size for of the proximity index for the original data set and xx-xxxx for the updated data set. Overall, the total number of percentile index peers or almost peers is twenty-one percent (21.1%) smaller than the total number of proximity index peers and almost peers. Percentile index peer and almost peer institutions are shown in Appendix C.

For the original data set, ten percentile index peer or almost peer institutions are neither a proximity index peer or almost peer. In fact, seven of these ten institutions are percentile index peers but neither a proximity index peer or almost proximity index peer. That is, over one-third (35.0%) of the percentile index peers index peers are not in any proximity index peer set. Similarly, one-third (33.3%) of the percentile index almost peers are not proximity index peers or

near peers. With one exception, institutions that were percentile index peers but not proximity index peers or almost peers were at the low end of the percentile index range (1.44 to 1.50) for peers.

Because there is no variability among the institutions for the proximity index almost peers (1.33) and the percentile index almost peers (1.44), possible explanations for why ten proximity index almost peers were neither a percentile index peer or percentile index near peer cannot be drawn from the range of peer and almost peer indices alone. An examination of the actual index distributions, however, may be in order. The index distributions, shown in Figure 2, are shaped differently than what is expected. For example, the proximity index should be very susceptible to outliers but in fact is more normal than the percentile index with a slight right skewness. Same can be said for the normative index distribution. The probabilities associated with the percentile index are fairly uniform except again, at the high end. Accordingly, the less varied probability may be the reason for the large proportion of percentile index peers compared to the index's almost peers. Because the probabilities are high throughout the distribution until about an index value of 1.50, more institutions were designated as peers than almost peers or not a peer.

A next logical step would be to investigate the individual index scores for each of the nine variables. Preliminary findings are actually somewhat confounding. The proximity index methodology was more likely to classify an institution as a peer than the other two indices but less likely to classify an institution as an almost peer. This is seen in Table 2. On the other hand, the percentile index methodology had a more equal split between the two peer groups with fifty-four percent (53.8%) of the index scores classifying institution as peers and forty-six percent (46.2%) of the index scores classifying institutions as near peers. Yet, the proportion of

percentile index peers to percentile index almost peers is much larger than the proportion of proximity index peers to proximity index peers (70% and 50% respectively).

Peer set inclusion for the updated data set was similar. ///

Normative Index. For the original data, the normative index range was the largest of the three indices: 1.38 to 1.89 and xx to 1.xx for the updated data set. For comparative purposes, the same cutoffs used for the other two indices were also applied to the normative index peer selection, 95th percentile or higher and between the 90th and 95th percentiles. For the original data, both the normative peer set is larger than both the proximity index and percentile index peer sets with 22 institutions. However, there are 12 normative index almost peers which is larger than the percentile index set of almost peers but considerably smaller than the proximity index almost peers. The updated data produced xx peer and xx almost peers institutions in the four peer sets are shown in Appendix D.

For the original data set, more than two-thirds (67.6%) of the normative index peer or almost peer institutions are also percentile index peer or almost peer institutions. Over seventy-five percent (76.5%) of the normative index peer or almost peer institutions are either percentile index peer or almost peer institutions.

The fact that there is more overlap between the normative index and percentile peer sets than the percentile peers sets is not surprising. Although the normative index was derived from the same metrics as the proximity index metrics, mean and standard deviation, the transformation to a standard normal curve improves its uniformity across the entire distribution. Perhaps, this is why the percentile index and normative index are relatively close in the final set of peers. Examined further, the skewness and kurtosis for each index were computed. Results are shown in Table 3. Skewness has already been discussed and identified as a factor in index

computations. More specifically, the differences in the symmetry of the index distributions may account for the difference in the institutions selected. As Table 3 and Figure 2 indicate, all index distributions are skewed with the percentile index with the largest skew (SE= -.031). This is peculiar since this index was designed with the objective of reducing asymmetry. The fact that there are two peaks or is bi-modal may account for this large skew statistic. Further, the additional mode seems to be interpreted as a high left tail rather than another peak.

Delving deeper into the data, the variables used in the indices are also skewed. Skewness and kurtosis for the seven continuously scaled variables are also shown in Table 3. All variables are positively or right skewed except for the Total Price of Attendance. Instructional Expenses is the most skewed (SE= 1.790).

Examining the index distributions' kurtosis may be in order. Kurtosis refers to the width of the peak of the distribution around the measure of central tendency (Hembree, 2013). As seen in Table 3 all the proximity, percentile, and normative indices all have negative kurtoses (β_2 = -508, β_2 = -1.118, and β_2 =- -9.34 respectively). Negative kurtosis is associated with distributions in which the probability is much more uniform than a normal distribution. A normal distribution would have a kurtosis of zero (DeCarlo, 1996). The proximity index is the least peaked, albeit negative, indicating that it is more peaked and has smaller tails on either side of the distribution than the other two indices. This is somewhat decipherable in Figure 2. Accordingly, the proximity index is less similar in the list of peers than the other two indices.

Conclusion

This study investigated the use of three peer selection indices: proximity, percentile, and normative. Several steps, eight in total, were needed to select a set of institutional peers and aspirants. These indices were used on a pre-determined set of institutions based on constituent

feedback and institutional priorities that help to identify key institutional characteristics. To select a set of peers that was well informed and aligned with strategic priorities, the following steps were needed: were used: (a) determination of what data to use (b) data element standardization, (c) regression modeling to identify the variables that were best correlated with key institutional attributes, (d) computing index scores and corresponding indices.

The crux of the research was to explore the efficacy of the three selection indices. In fact, this research is innovative in that this was the first time that two of the indices: percentile and normative were formally investigated. As with our previous research, no methodology is endorsed but simply introduced as a plausible option.

Because of the number of institutions in the initial data sets (N=287 and N=267 for the original and updated data sets respectively), the 95th percentile was used as the cut-off for peers for every index. However, another set of almost peers were also identified using the 90th percentile as the cut-off. The two-tiered system to classify the proximity of the institutions to the target institution is practical in light of the large number of initial institutions as well as the relatively small range of index scores for all three indices.

The proximity index produced the largest number of peers, 38. The percentile index produced the fewest number of peers, 30. Overlap of peers among the indices was sizeable but not perfect. Approximately two-thirds (66.6%) of the peers or almost peers identified by the proximity index were also included in the percentile indices peer lists. A similar proportion was observed for the proximity index and the normative index with the normative peers sets with a sixty-seven percent (67.6%) match between indices. The most pronounced match was between the percentile and normative indices with eighty-seven percent (86.7%) of all percentile index peer and almost peer institutions were also normative index peers or almost peers. In reverse

however, only seventy-six percent (76.4%) normative index peer or almost peer institutions were also in the percentile peer lists.

Albeit minor, there are inherent differences among the indices that might explain the discrepancies. As a starting point, the discrepancies between the normative index peer and almost peer institutions and the percentile index peer and almost institutions were discerned for the seven continuously scaled variables. As a baseline, institutions that were neither normative index peers or almost peers or percentile index peers or almost peers were included in the comparisons. Normative index peer and almost peer institutions were further distinguished as being only a normative index peer or almost peer institution or being both a normative index peer or almost peer institution and a percentile index peer or almost peer institution.

Means and standard deviations for the seven continuously scaled variables for each index grouping are listed in Table 4. The 25th Percentile Mathematic SAT mean, the Percent of Full-time Students Receiving Federal Aid mean, and the Total Price of Attendance mean for the normative/ percentile index institutions are closer to the target institutions values than the other two groups. On the other hand, the normative index only institutions posted means for Faculty Salary and FTE are closer to the target institution compared to the other two groups. Institutions that did not fall in either the normative index or peer index peer groups posted means for the Instructional Expenses Per FTE and Alumni Giving rate variables that were closest to the target institution. Further investigation revealed that the proximity index peers or almost peers had a mean for the Instructional Expenses Per FTE variable that was nearer than the other two selection index institutions. Interestingly but not surprisingly, the target institution was at the low end of the distribution for both these variables, Instructional Expenses Per FTE and Alumni Giving Rate. On the other hand, the target institution was on the high end of the distribution

when it was closest to the means for the normative index institutions. When the target institution was closer to the middle of the distribution, the normative/percentile index institution means were nearest. The exception is the Percent of Full-time Students Receiving Federal Aid; the target institution is on the low end of the distribution for this variable.

In brief, the normative index was most perceptive in choosing peers and almost peers when the target institution was at the high end of the distribution. The combined normative/ percentile index fared well with variables in which the target institution was toward the middle of the distribution. When the target institution was at the low end of the distribution, the identification of peers was more varied and less evident. Because all but one of the seven continuously scaled variables, Total Price of Attendance, were right skewed, perhaps that is why the normative index peer and almost peer institutions differs slightly from the percentile index peers and almost peer sets. In fact, as this investigation shows, the percentile index is less immune from non-normal distributions but may eliminate unnecessarily institutions that are close to the target institution on variables whose distributions are non-normal.

Comparisons among the original data set and the updated data set reinforce the importance of regularly verifying an institution's list of peers. /////As seen, the set of peers changes regardless of the index used. Reasonable is to expect that institution characteristics and priorities change over time. As such, peer lists can become outdated, irrelevant, and comparisons among the peers inappropriate.

Finally, the different generated lists among the indices demonstrates the importance of due diligence before and during the selection process. Feedback from faculty and staff are key to this thoroughness. Constituents not only help to identify institutional priorities but reinforce

their importance. Additionally, their participations increases acceptance of the chosen set of peers.

Examining the set of institutions gleaned by each index affords both a comparison of the appropriateness of each institution as a peer and the set of institutions as a reasonable peer group (D'Allegro & Zhou, 2013). That said, as this study illustrated, the choice of initial set of institutions is crucial. These institutions should be approximate to the target institution by proxy of both institutional characteristics and the variables that will ultimately be used to choose a set of peers.

As this study demonstrates, peer selection based on a multi-staged approach is necessary but not sufficient. Careful vetting of the appropriateness of the actual statistical steps and methodology are needed. As an example, several OLS regressions were used to determine the best predictors of institutional quality, the mainstay of the target's priorities. However, other methodologies could be employed including ////. Additionally, what is included in the model is important. Five different models for each of the three key performance factors were chosen to ensure variability among institutional characteristics. Most importantly, the examination of the data itself is in order. As the comparison of the distributions for each of the three indexes and the nine variables that comprise each index revealed, outliers and resulting non-normal distributions has a profound impact on the selection of peers.

Recommendations

The purpose of the study was to provide flexibility in peer selection rather than to identify the best peer selection index. In light of the countless applications and wide variety of institutional types and missions, this was deliberate. That said, care should be taken to determine the best selection index or combination of selection indices as was warranted by the data sets

used in this study. Preliminary analyses of the initial set of institutions as well as the data variables should be undertaken. As done here post-hoc, scrutiny of the variables' distributions, location of the target institution on the variable distributions, and other anomalies should be identified and considered a priori to the actual determination of peers.

As mentioned, the importance of the data elements, method, and statistical calculations cannot be overstated. Both the type of institution as well as purpose of the peer selection are key in determining the most appropriate information to collect (Shin, 2009). The use of historical information, data trends, or the most current data are posited as options but may not all be appropriate. As was the case in this study, historical information gleaned different set of peers than updated data.

Following the logic of the of a two-tier taxonomy, two sets of peers were identified: peers and almost peers. This affords the flexibility of choosing peers for different purposes and audiences. In addition, it somewhat mutes the imperfections of both the selection methodologies and the somewhat indecisive of any of the three selection indices to choose a set of peers.

As of this study there are few publications on peer selection methodologies. More conclusive evidence is needed about peer selection models and the effect of target institution type might have on those models. As mentioned, the impact of peer comparisons on institutional quality and improvement has not been studied. Evaluation that invokes the use of peers seems to be in vogue but the question remains. Is peer comparisons or benchmarking superior to other types of comparative assessments or non-comparative evaluation? In time, further research should be able to verify.

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Table 1

Overall OLS Regression Models for the Three Performance Indicators: Ratio of Conferred Bachelor's Degree to FTE, One-Year Retention Rate, and Six-Year Graduation Rate

Category	Variable*	Standardized Beta Weight
Ratio of Conferred Bachelor's Degrees to FTE		
Admissions	25th Percentile Mathematics SAT	.348*
Faculty	Average Faculty Salary	-.142
Enrollment	Estimated Fall Enrollment to FTE	-.053
Institutional Characteristics	Selectivity	.282**
Finance	Instructional Expenses	.166
One-Year Retention Rate		
Admissions	25th Percentile Mathematics SAT	.465***
Faculty	Average Faculty Salary	.135
Enrollment	FTE	.064
Institutional Characteristics	Selectivity	.301***
Finance	Instructional Expenses	.065
Six-Year Graduation Rate		
Admissions	Percent of First Time Federal Grant Aid Students	-.145**
Faculty	Average Faculty Salary	.211**
Enrollment	FTE	.090
Institutional Characteristics	Selectivity	.178***
	Proportion of Transfer Students	-.104**
Finance	Total Price of Attendance	.007
	Instructional Expenses	.224***
	Alumni Giving Rate	.186*

* $p \leq .05$, * $p \leq .01$, ** $p \leq .001$

Table 2

The Nine Variable Peer and Almost Peer Classifications for the Three Selection Indices

Index	Peer		Almost Peer	
	N*	Percent**	N*	Percent**
Original Data Set				
Proximity	813	65.6%	426	34.4%
Percentile	638	53.8%	547	46.2%
Normative	756	60.8%	487	39.2%
Updated Data Set				
Proximity		%		%
Percentile		%		%
Normative		%		%

* Sum of index scores for each of the nine variables. Index scores not available for all variables

** Percent of index scores that were between 1 and 2.

Table 3

Skewness and Kurtosis for the Three Selection Indices

Index	N	Mean	Standard Deviation	Skewness	Kurtosis
Original Data Set					
25th Percentile					
Mathematics SAT	231	490.10	75.223	.562	-.145
Percent of Full-time					
Students Receiving					
Federal Aid	286	40.300	20.986	.828	.277
Average Full-time					
Faculty Salary	285	61,955.15	15,133.428	.735	.986
FTE	286	1671.52	627.450	.951	
Total Price of					
Attendance	282	40,328.93	9,549.41	-.007	-.222
Instructional Expenses					
Per FTE	284	10,035.78	5,976.134	1.790	4.096
Alumni Giving Rate	250	21.892	11.894	.701	.366
Proximity Index	286	.797	.427	.004	-.508
Percentile Index	286	.794	.489	-.031	-1.118
Normative Index	286	.812	.446	-.013	-.934

Table 3 (continued)

Skewness and Kurtosis for the Three Selection Indices

Index	N	Mean	Standard Deviation	Skewness	Kurtosis
Updated Data Set					
Mathematics SAT					
Percent of Full-time					
Students Receiving					
Federal Aid					
Average Full-time					
Faculty Salary					
FTE					
Total Price of					
Attendance					
Instructional Expenses					
Per FTE					
Proximity Index					
Percentile Index					
Normative Index					

Table 4

Mean & Standard Deviations of Seven Continuously Scaled Variables for Normative Index Only Institutions, Normative/Percentile Index Institutions, and Neither Normative/Percentile Index Institutions

	Normative Only			Normative/ Percentile			Neither		
Index Group	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Original Data Set									
25th Percentile									
Mathematics SAT	8	570.00	29.28	26	533.19	25.32	197	481.16	77.08
Percent of Full-time									
Students Receiving									
Federal Aid	8	19.88	6.24	26	24.62	5.30	252	42.60	20.24
Average Full-time									
Faculty Salary	8	71,280	7,007	26	70,494	4,7675	251	60,773	16,644
FTE	8	2408.00	693.18	26	2185.46	660.69	242	1595.12	582.78
Total Price of									
Attendance	8	47,814	8,489	26	45,883	4,294	248	39,494	9,700
Instructional Expenses									
Per FTE	8	14,132	2,923	26	11,957	2,719	251	9,706	6,210
Alumni Giving Rate	8	26.88	7.32	26	22.00	8.07	216	21.66	12.37

Table 4 (continued)

Mean & Standard Deviations of Seven Continuously Scaled Variables for Normative Index Only Institutions, Normative/Percentile Index Institutions, and Neither Normative/Percentile Index Institutions

	Percentile Only			Percentile/Normative			Neither		
Index Group	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation
Updated Data Set		3							
25th Percentile									
Mathematics SAT									
Percent of Full-time									
Students Receiving									
Federal Aid									
Average Full-time									
Faculty Salary									
FTE									
Total Price of									
Attendance									
Instructional Expenses									
Per FTE									
Alumni Giving Rate									

* $p \leq .05$, * $p \leq .01$, ** $p \leq .001$

Table 5

ANOVA for Percentile Index Only Institutions, Normative/Percentile Index Institutions, and Neither Normative/Percentile Index Institutions

Index Group	N	Mean	Standard Deviation	F
Percentile Only				
Percentile/Normative				
Neither				

* Sum of index scores for each of the nine variables. Index scores not available for all variables

** $p \leq .05$, * $p \leq .01$, ** $p \leq .001$

Figure 1

Proximity and Aspirant Index Numeric Assignments for Differences Between Reference College and Institution

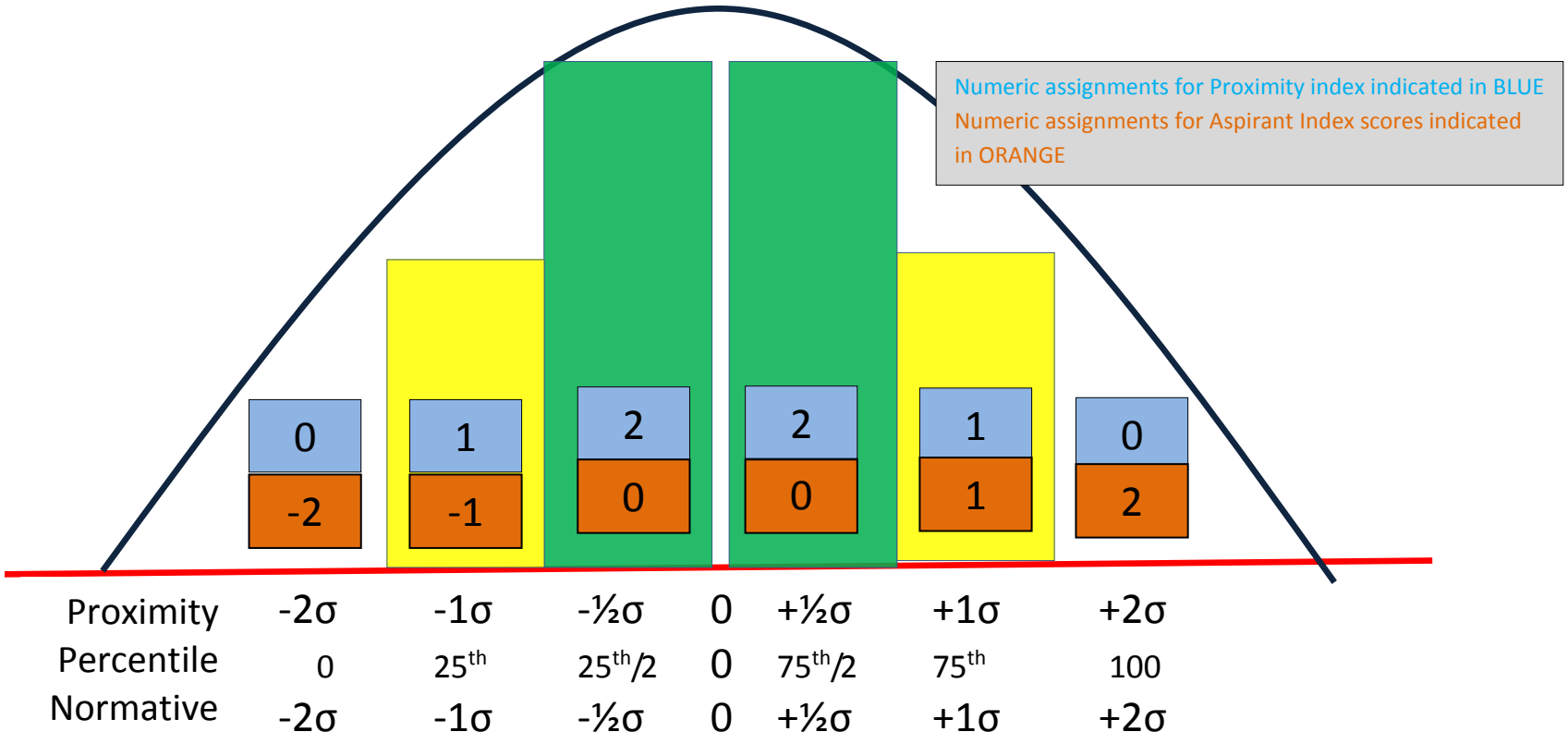
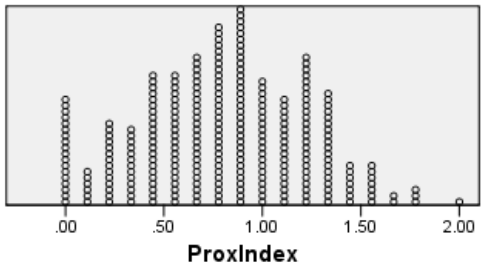
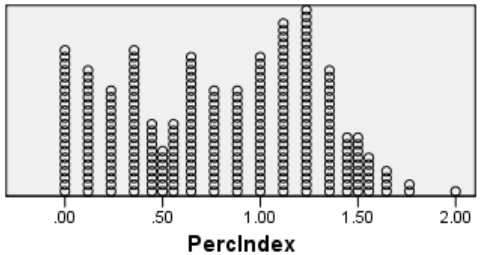


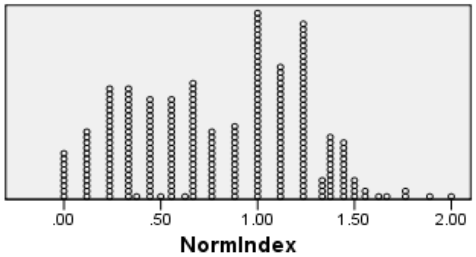
Figure 2

Index Distributions

ORIGINAL DATA SET







UPDATED DATA SET

Appendix A

Data Elements Used for Peer and Aspirant Selection: Time Frame, Indicator Type, and Source

Variable	Time Frame	Indicator Type	Indicator Source
Admit Yield	2011–2012	Admissions	IPEDS
Number of Applicants, Total	2011–2012	Admissions	IPEDS
Percent of Applicants Admitted	2011–2012	Admissions	IPEDS
SAT Critical Reading 25th Percentile Score	2010–2011	Admissions	IPEDS
SAT Critical Reading 75th Percentile Score	2010–2011	Admissions	IPEDS
SAT Math 25th Percentile Score	2010–2011	Admissions	IPEDS
SAT Math 75th Percentile Score	2010–2011	Admissions	IPEDS
Bachelor's Degrees Conferred	2010–2011	Completions	IPEDS
Estimated Fall Enrollment	Fall 2010	Enrollment	IPEDS
Full-Time Equivalent (FTE)	Fall 2010	Enrollment	IPEDS
Total Enrollment, Unduplicated	2010–2011	Enrollment	IPEDS
Percentage of Classes Enrolling Fewer Than 20 Students	2011–2012	Enrollment	U.S. News & World Report
Average Salary Equated to 9-Month Contracts of Full-Time Instructional Staff: All Ranks	2011–2012	Faculty	IPEDS
Full-Time Primary Instruction Head Count	Fall 2011	Faculty	IPEDS
Part-Time Primary Instruction Head Count	Fall 2011	Faculty	IPEDS
Percentage of Faculty Holding Terminal Degrees	2011–2012	Faculty	U.S. News & World Report
Endowment (FASB)	2009–2010	Financial	IPEDS
Instructional Expenses Per FTE (FASB)	2009–2010	Financial	IPEDS
Tuition Total Price for In-District Students Living on Campus	2011–2012	Financial	IPEDS
Alumni Giving Rate	2011–2012	Financial	U.S. News & World Report
Percent of Full-Time Undergraduates Receiving Federal Grant Aid	2010–2011	Financial Aid	IPEDS
Carnegie Classification: Basic (Arts & Sciences or Diverse Fields)	—	Institutional Characteristic	IPEDS
Carnegie Classification: Enrollment Size & Setting	—	Institutional Characteristic	IPEDS
Carnegie Classification: Undergraduate Profile (Transfer & Full-Time Proportions)	—	Institutional Characteristic	IPEDS
Geographic Region	—	Institutional Characteristic	IPEDS
Level	—	Institutional Characteristic	IPEDS
Religious Affiliation	—	Institutional Characteristic	IPEDS
Tribal College	—	Institutional Characteristic	IPEDS
Graduation Rates, Total Cohort (6 Years)	As of Aug. 31, 2010	Student Success	IPEDS
Retention Rates, Total Cohort (1 Year)	Fall 2010	Student Success	IPEDS

Appendix B

Data Element Used for Peer and Aspirant Selection: Descriptions

Admissions

Admit Yield- Number of enrolled divided by the number admitted.

Number of Applicants, Total - Number of first-time, degree/certificate-seeking undergraduate students who applied (full or part time). Includes early decision, early action, and students who began studies during the summer prior to that fall.

Percent of Applicants Admitted- Number of admitted divided by the total applicants.

25th percentile Critical Reading SAT score- 25th percentile Critical Reading score. Includes new students admitted the summer prior to that fall.

75th percentile Critical Reading SAT score - 75th percentile Critical Reading score. Includes new students admitted the summer prior to that fall.

25th Percentile Mathematics SAT score - 25th percentile Mathematics score. Includes new students admitted the summer prior to that fall.

75th percentile Mathematics SAT score - 75th percentile Mathematics score. Includes new students admitted the summer prior to that fall.

Percent of Full-Time Undergraduates Receiving Federal Grant Aid- Percent of undergraduate students receiving grant aid from the federal government. Undergraduates are students enrolled in a 4- or 5-year Bachelor's degree program, an associate's degree program, or a vocational or technical program below the baccalaureate.

Faculty

Average Salary Equated to 9-Month Contracts of Full-Time Instructional Staff- All Ranks- Derived by summing the equated 9-month outlays for each rank and dividing by the total faculty on both 9/10 month and 11/12 month contracts.

Full Time Primary Instruction Head Count- Instructional faculty are instruction/research staff employed full time (as defined by the institution) whose major regular assignment is instruction, including those with released time for research.

Part Time Primary Instruction Head Count – Faculty reported to have a primary function of instruction that does not exceed 50%.

Percentage of faculty holding terminal degrees – The percentage of full-time faculty members with a doctorate or the highest degree possible in their field or specialty during the academic year.

<u>Enrollment:</u>
Estimated Fall Enrollment- Early estimate of enrollment for all levels for full- and part-time students.

Full Time Equivalent (FTE)- The full-time equivalent of the institution's part-time enrollment is estimated and then added to the full-time enrollment of the institution. The full-time equivalent of part-time enrollment is estimated by multiplying the part-time enrollment by factors that vary by control and level of institution and level of student.

Total Enrollment, Unduplicated- The sum of students enrolled for credit with each student counted only once during the reporting period, regardless of when the student enrolled.

Percentage of Classes Enrolling Fewer than 20 Students – The percentage of undergraduate classes, excluding class subsections, with fewer than 20 students enrolled during fall semester.

Institutional Characteristics

***Carnegie Classification*- Basic (Arts & Sciences or Diverse Fields)** – (Baccalaureate Colleges). Includes institutions where baccalaureate degrees represent at least 10 percent of all undergraduate degrees and that award fewer than 50 master's degrees or fewer than 20 doctoral degrees per year. Excludes Special Focus Institutions and Tribal Colleges.

***Carnegie Classification*- Enrollment Size & Setting-** School sizes are classified by very small, small, medium, large. Also indicates proportion of students living in campus housing.

***Carnegie Classification*- Proportion of graduate degrees conferred**

***Carnegie Classification*- Undergraduate Profile** - used in this case study to determine selectivity

Geographic Region –US region school where institution is located.

Level- A classification of whether an institution's programs are 4-year or higher (4 year), 2 year and less than 4-year (2 year), or less than 2-year.

Religious Affiliation- Indicates religious affiliation (denomination) for private non-profit institutions that are religiously affiliated.

Tribal College- These institutions, with few exceptions, are tribally controlled and located on reservations, and are all members of the American Indian Higher Education Consortium.

Financial

Alumni Giving Rate – The average percentage of undergraduate alumni (full or part-time students) who donated money to the college or university for either current operations or capital expenses during the specified academic year Rate is calculated by dividing the number of alumni donors during a given academic year by the number of alumni of record for that same year.

Endowment (FASB)- Endowment assets (yearend) per FTE enrollment for public and private not-for-profit institutions using FASB standards is derived as follows: Endowment assets (yearend) divided by 12-month FTE enrollment. Endowment assets are gross investments of endowment funds, term endowment funds, and funds functioning as endowment for the institution and any of its foundations and other affiliated organizations. Endowment funds are funds whose principal is nonexpendable (true endowment) and that are intended to be invested to provide earnings for institutional use. Term endowment funds are funds which the donor has stipulated that the principal may be expended after a stated period or on the occurrence of a certain event. Funds functioning as endowment (quasi-endowment funds) are established by the governing board to function like an endowment fund

but which may be totally expended at any time at the discretion of the governing board. These funds represent nonmandatory transfers from the current fund rather than a direct addition to the endowment fund, as occurs for the true endowment categories.

Instructional Expenses Per FTE (FASB)- Includes all expenses of the colleges, schools, departments, and other instructional divisions of the institution and expenses for departmental research and public service that are not separately budgeted. Includes general academic instruction, occupational and vocational instruction, special session instruction, community education, preparatory and adult basic education, and remedial and tutorial instruction conducted by the teaching faculty. Also, includes expenses for both credit and non-credit activities. Excludes expenses for academic administration if the primary function is administration (e.g., academic deans).

Total Price for In-District Students Living On-campus- Cost of attendance for full-time, first-time degree/certificate seeking in-district undergraduate students living on campus for academic year. It includes in-district tuition and fees, books and supplies, on campus room and board, and other on campus expenses.

Performance Indicators

Conferred Bachelor's Degrees Conferred- Awards/degrees conferred.

Graduation Rates, Total Cohort (Six Years)- The number of students from the adjusted conferred Bachelor's degree-seeking cohort, who completed a Bachelor's degree within 150 percent of normal time (6-years) divided by the adjusted cohort. The adjusted cohort is the revised cohort minus exclusions as reported by the institution as of 150 percent of normal time (6-years).

Retention Rates, Total Cohort (One Year)- The full-time retention rate is the percent of the (fall full-time cohort from the prior year minus exclusions from the fall full-time cohort) that re-enrolled at the institution as either full- or part-time in the current year.

////Appendix C

Siena College Peers Lists

Near Peers	
Institution	**State**
Allegheny College	PA
Cedarville University	OH
Champlain College	VT
College of Saint Benedict	MN
Concordia College at Moorhead	MN
Cornell College	IA
Gordon College	MA
Hartwick College	NY
Hope College	MI
Juniata College	PA
Messiah College	PA
Oglethorpe University	GA
Saint Michael's College	VT
Stonehill College	CT
Susquehanna University	PA
Transylvania University	KY
Wentworth Institute of Technology	MA
William Jewell College	MO
Wofford College	SC

Almost Near Peers	
Institution	**State**
Augustana College	IL
Birmingham Southern College	AL
Calvin College	MI
Carroll College	MT
Goucher College	MD
Hampshire College	MA
Houghton College	NY
Lake Forest College	IL
Lasell College	MA
Linfield College-McMinnville Campus	OR
Luther College	IA
Muhlenberg College	PA
Saint Anselm College	NH
Saint Vincent College	PA
Southwestern University	TX
St Olaf College	MN
Trine University	IN
Washington College	MD
Westmont College	CA