WESTERN KENTUCKY UNIVERSITY'S ATHLETIC PROGRAM: FINANCIAL BURDEN OR BOON?

A REPLY

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INTRODUCTION

In March, 1989, the Fiscal Affairs Committee of the Faculty Senate completed a study and presented a document entitled Report on Financing of Intercollegiate Athletics 1987-88 (hereinafter referenced as the Vos report). One of the findings of the report was that the excess of expenditures over revenues in the football program has steadily grown over the last decade, and is now approaching a million dollars per year. In the last year surveyed, the cost in excess of revenues was over $800,000 -- even with the income from post-season play that year. The report, which was the fifth in a series, gave a thorough analysis of arguments used to defend trends in intercollegiate athletics and its cost. Included among its conclusions were: that expenditures and deficits for Western's athletic program continue to grow, that football continues to be a major contributor to the worsening financial situation, and that there is still no evidence that intercollegiate athletics affects the enrollment at Western.

In November, 1989, Robert Pulsinelli, Melvin Borland, and Brian Goff, of the Department of Economics at Western Kentucky University, completed a report entitled: Western Kentucky University's Athletic Program: Financial Burden or Boon? In the report the authors state that, according to their statistical model, the football and basketball programs may have attracted 1459 students to Western in the 1988-89 academic year. They argue, on the basis of hypothesized "enrollment-enhancement effects" of Western's intercollegiate sports programs, that WKU football and men's basketball contributed net revenues of $1.2 million and $4.9 million, respectively, in 1988-89.

The gist of the argument of Pulsinelli, Borland, and Goff (PBG) is that (i) the Commonwealth grants to WKU certain funds for each student enrolled here; (ii) the athletic program results in a net increase in enrollment; (iii) thus, the athletic program brings in revenues not attributed to it in the University budget. Furthermore, (iv) this purely athletic-related increase in enrollment is sufficiently great to make the athletic programs show a profit, when it is taken into account. Point (iv) depends, of course, on point (ii), which PBG attempt to demonstrate by means of an argument that might, to a casual reader, give the appearance of being entirely statistical in nature, but which, in fact, is not.

Comments concerning the argument of PBG can be classified into the following groups:

(1) Questionable Assumptions,
(2) Omitted Considerations,
(3) Inconsistent Results,
(4) Faulty Logic,
(5) A Flawed Statistical Model.

Each of these topics will now be considered in turn.

COMMENTS

(1) Questionable Assumptions.

PBG assume that WKU is operating at less than full capacity. Given that the University has been operating with full dormitories for the last two academic years (also, the administration is planning on increasing the number of dormitories and that enrollment caps have been seriously discussed), this assumption is, at least, disputable. Empty classrooms do not indicate an inadequate number of students, but are a matter of student preferences for early classes rather than late afternoon classes. Classrooms are empty on weekends because the university, like most others, does not hold classes on weekends.

They further assume that no student athletes would attend Western if their particular sport were dropped. This assumption is not self-evident. It is not inconceivable that some student athletes would attend Western in order to receive an education. If student athletes choose not to attend WKU, they would most likely be replaced by other students.
The assumption is made that, in Western's case, a small positive correlation between sports performance and enrollment increases does imply that the sports performance actually caused the enrollment increase (rather than the relation either being accidental, or being due to both phenomena having a third cause or set of causes). PSG suggest some reasons why this correlation "strongly implies a causal relationship." We shall discuss these reasons under section (4).

That it was necessary to make this last assumption is particularly significant in view of the fact that it is an essential component in an argument whose purpose is to demonstrate that the athletic program results in an increase in enrollment.

(2) Omitted Considerations

PSG seek to identify marginal benefits (i.e., "hidden" benefits not associated in the University budget with the athletic program) of the athletic program, but do not seek to identify or include all the marginal costs of the program: e.g., extra security and utility costs, adverse publicity due to poor athletic performance, the diversion of funds which could otherwise be used to recruit outstanding students, etc.

In particular, they do not consider the possibility that a losing season may actually have a negative effect on enrollment. Their statistical model is constructed so that the effect of athletic performance on enrollment is always positive, or at worst -- if a team wins no games in the season -- zero. That is, if, for example, the basketball team were to win only one game in the entire season, the net effect on enrollment would be an increase.

According to the PSG model, the only way a team could have a detrimental effect on enrollment would be for it to lose more games than it played. Thus, although it is assumed that success increases enrollment, it is not assumed that failure decreases it.

The only WKU activities that PSG include in their model as possible causal factors are basketball and football performances, omitting such plausible factors as recruiting efforts, academic grants and scholarships, admissions policies, inducements for students from neighboring states, fluctuations in retention and graduation rates, and for that matter, other sports. Every factor that correlates positively with enrollment increases is a candidate for consideration as a cause of increased enrollment. To each such factor that is included in the model, there will be attributed, by the model, a certain number of "extra" students as its share of the enrollment increases for a given year. As the actual enrollment increase for a given year is a fixed number, it is obvious that one cannot continue including positively-correlating factors indefinitely; one must limit oneself to the factors which are known on other grounds to be causal factors, and include those with the highest correlation coefficients down to the point at which all but an insignificant amount of the variance is accounted for. There is no evidence in their report that PSG followed this (standard) procedure.

If the argument of PSG were without flaw, they would have demonstrated, not a positive effect of athletic expenditure on enrollment, but a positive effect of athletic record (and that mainly of basketball) on enrollment. Their report does not address the question of what would be the effect on enrollment of a better athletic record in a lower, and less expensive, conference. Furthermore, the overwhelming portion of the enrollment increase attributed to basketball and football is, in fact, attributed to basketball, the less expensive sport. PSG do not consider the obvious corollary: to spend the money on the sport which is, on their showing, more cost-effective.

PSG do not address the question of whether, even if large expenditures on athletic programs were to produce an increase in enrollment, such expenditures are the most efficient, the most cost-effective, or the most desirable means of arriving at this result. There are other ways to attract students; e.g., recruiting and advertising. It could be claimed that, if the budget deficit of the athletic program were devoted instead to academic scholarships, the number of extra students attracted would be at least as large as that claimed for the athletic program, and the students attracted might be of a very different type. Given the mission of a university, it may be preferable to attract students whose interest is in acquiring an education rather that those whose choice of a university
is based solely on watching other students play games. Even if the total amount of money spent on athletic activities were not decreased, it might be more effective at attracting students if more funds were spent on athletic activities in which more students could participate, and less spent on a small group of highly-trained specialists.

(3) Inconsistent Results.

PBG find enrollment increases to be positively correlated with basketball winning percentages and with football participation in post-season play, but not with football winning percentages or basketball participation in post-season play. As a team's opportunity to participate in post-season play is based on its winning percentage, it follows that, if there is a causal relation between winning percentage and enrollment increase, or between participation in post-season play and enrollment increase, then all three factors should be positively correlated. That PBG do not find them to be casts doubt on the interpretation of these small correlations as signifying causation.

An additional model for enrollment levels [PBG, p. 19] included enrollment at all Kentucky universities, which was found to be statistically significant. They say "as suggested previously, differencing the enrollment series, diminishes the explained variation in the series. This is a characteristic of almost all time series." On page 18, their model using differences in enrollment, did not find general Kentucky enrollment to be significant. The results of the two models are, in this matter, contradictory. The authors, in the above quotation, explain why: it is due to the model specification. This means that the significance of state-wide enrollment exists but may not be captured by the PBG model because of the variables used; indicating that the relation between WKU enrollment and trends and Kentucky enrollment trends can exist but is missed by the PBG model because the model is incorrectly specified. The results they find depends on how they set up their equation.

(4) Faulty Logic.

PBG argue against a hypothetical opponent who advocates eliminating Western’s athletic program altogether. To the best of our knowledge, no responsible body on this campus has proposed such a step. The question at issue is not whether we should have athletic programs, but what their nature should be and how much we should spend on them. It is inappropriate to argue as if the only alternative to our present pattern of athletic spending is no athletic spending at all. We have pointed out, in section (1), that PBG assume that no student athlete would attend Western if his/her particular sport were dropped. The relevant question is, would student athletes not attend Western if the amount of money spent on their particular sports were reduced?

Some persons appear to have the impression that PBG have demonstrated, by means of a purely statistical analysis, that athletic performance (of certain types) causes increases in enrollment. As we shall show, their statistical model is inaccurate. However, even if the PBG model were accurate, it would not establish this causation. The most that can be claimed for the model is that it demonstrates a small correlation between athletic performance and enrollment increases. (We shall see, in the next section, that this correlation is not statistically significant.) It is a truism in statistics, and PBG correctly state it, that correlation does not imply causation. The correlation could be merely accidental, or it could be that both factors are caused by other agents, but have no causal relation with one another. (An example would be the positive correlation between the number of bees in Bowling Green and the number of people wearing shorts. Bees do not cause people to wear shorts, and shorts do not produce bees. Both effects are due to other causes.) PBG then attempt, and it is on this attempt that their entire argument rests, to show that, in this case, the correlation is indeed the result of causation. If this attempt is not conclusive, their argument fails, and their statistical analysis is irrelevant.
The attempt is made up of three "reasons" why the correlation PBG find between an enrollment increase in a given year and athletic success in the two preceding years "strongly implies a causal relationship." These are:

(i) "A theoretical link between athletic success and enrollment clearly exists." That is, PBG simply assume that one of the factors that attract students to a particular university is the success of its athletic program. As this is the major point at issue, and is strongly denied in the Vos report on athletic spending, its use here as an assumption is a glaring petitio principii: to the extent that the argument of PBG rests on this assumption, it is assuming its conclusion, and is circular.

(ii) PBG then rule out the possibility that the correlation between enrollment increase in a given year and athletic success in the two preceding years is due to the athletic success being caused by the enrollment increases. As this would involve causation acting backward in time, we can all agree on this point. However, using the word "causation" in a sentence and saying that the later point cannot cause the earlier one does not mean there is actual causation in the other, allowable direction in time.

(iii) Lastly, PBG assert that the statistical results (correlation with athletic success in the two previous years) provide evidence that the correlation is not spurious, since they do not find a link between an enrollment increase in a given year and athletic success in the same year (which, in their words "would obviously be spurious"). The difference is apparently an artifact of their auto-regressive modeling procedure. As discussed in the next section, and in the Appendix a multiple regression analysis finds no significant correlation with either case.

The authors state (page 19) "... a finding of correlation between variables does not necessarily imply causation." But, the authors also state that for their model which shows correlation between variables that "we suggest some reasons why this result STRONGLY (emphasis added) implies a causal relationship." Given the correlations in their model, the authors cannot imply or interpret causation since correlation does not show causation. The three reasons given (pages 19-20) for causation are just speculation on their part and the authors have not proven causation. Saying they believe there is causation does not make it so.

We see, then, that the interpretation of the statistical results of the PBG statistical model as indicating a causal relation between athletic success and enrollment increase is based on (a) a circular argument, and (b) a very small difference between two small correlation coefficients. These are two very slender pegs on which to hang the heavy expenditures of Western's athletic program.
(5) Statistical Analyses of Enrollment and Sports Data

On the basis of their statistical model for yearly changes in WKU enrollment, Pulsinelli, Borland, and Goff (PBG) maintain that Western's basketball wins and football post-season participation can be responsible for large yearly increases (over 1400 students) in Western's enrollment figures. However, a detailed evaluation of the PBG model in relation to the data reveals a number of problems with their model. The data and the analyses are presented in full in the Appendix of this report. We discuss and illustrate the principal findings in the current section.

PBG indicate that enrollment changes for all other Kentucky colleges and universities provide no additional explanatory power in their model for changes in Western's enrollment. This is a major shortcoming of their model, since there is actually a strong correlation between changes in enrollment at WKU and enrollment changes in Kentucky. This relationship is indicated by the graph below, in which we have scaled and superposed plots of enrollment changes at WKU and at all other Kentucky colleges and universities.

The strong correlation between WKU and other Kentucky enrollment changes is verified by regression analysis, which is described in the Appendix.

That Western's enrollment changes reflect those of the rest of the Commonwealth is not surprising; it is to be expected that Western will share more-or-less proportionately in statewide enrollment changes, which represent the "pool" from which schools such as Western draw their additional enrollment. A model that finds no relationship between these highly correlated sets of data is seriously flawed.

The PBG model for changes in Western's enrollment is based on an auto-regressive principle for time series analysis (ARIMA or Autoregressive Integrated Moving Average) that is supposed to "control for systematic movements in enrollment" in order to "extract as much information as possible from the series itself about systematic movements in the series" [quotes from PBG, p. 16]. In principle, the ARIMA process attempts to predict the enrollment change for a given year based on the previous year's enrollment change. The basic ARIMA model is essentially a time-shifted fractional replica of the time series itself. It preserves fluctuations that are very similar to the observed data, since it is derived from the observed data by a multiplicative constant. However, the model fluctuations are time-shifted forward by one year, relative to the observed fluctuations. The modeling process includes an additive constant, which can have the effect of shifting the entire replica vertically, relative to the observed data. It is important to note the following three points about the PBG application of ARIMA models:

(i) ARIMA-based models are inappropriate for the present case. PBG attempt to use an ARIMA model to establish that athletic success is a causative factor in increasing enrollment at WKU. They introduce their use of ARIMA models with the statement: "This is a commonly employed technique for modeling time series data" [PBG, p. 16]. What is not made clear is that ARIMA models were derived for the purpose of forecasting the future behavior of time series, from their past behavior, not for discovering causal relations.
A sample size of at least 50 data points is recommended as a minimum data set for proper application of the ARIMA procedure (A. Pankratz, *Forecasting with Univariate Box-Jenkins Models*, New York: John Wiley and Sons, 1983). The ARIMA models calculated by PSG are based on a sample of only 29 data points.

The application of an ARIMA model to predicting changes in WKU enrollment is based on the assumption that the best indication of this year's change is last year's change. The addition of sports variables to the ARIMA-based PSG model is based on the assumption that sports performance influences enrollment.

Sample ARIMA fits discussed by PSG are plotted in the figures below, beginning with the case of an ARIMA-ONLY fit to the data, with no added sports terms.

We see from the graph above that the ARIMA-ONLY prediction curve follows the observed WKU enrollment change near the beginning of the data set, but it lies systematically above the observed curve over most of the time period. This ARIMA model therefore tends to predict more enrollment increase at WKU than actually occurred. Of course, the pattern of fluctuations in the two curves are similar, due to the ARIMA process, which essentially time-shifts the major fluctuations in the observed series forward by a year. The major problem with the model, however, is indicated by the graph of its errors, or residuals (predicted values minus observed values), plotted above at the right. The goal of a good statistical model is to leave residuals that are essentially white noise, or random values with a mean of zero. The errors of the ARIMA-ONLY model are not randomly distributed about zero, but are systematically positive. This indicates that the ARIMA model is systematically in error, generally predicting enrollment increases for Western that are systematically higher than the actual increases shown by the data.

The assumption is made by PSG that any "error", or difference between an ARIMA representation and the observed series, can be presumed to be due to other factors. Although PSG acknowledged that statistical correlation does not necessarily imply causation, they proceeded "to determine the impact of athletics" [PSG, p. 17] by including separate additional variables representing WKU sports performance indices. At this point, it should be noted that the ARIMA model has already overestimated the enrollment changes, and there is no excess of enrollment over that which is predicted by the ARIMA model, which might require explanation due to other factors.

Nevertheless, PSG derived a model based on the ARIMA process with the inclusion of additional variables representing WKU sports performance records [PSG, p. 17]. The figures below represent the final PSG model for changes in WKU enrollment, including posited sports effects.

Referring to the following graphs, we see that the full PSG model essentially accommodates hypothetical additive sports terms with an ARIMA component (labeled "ARIMA-BASE") that has been shifted downward, falling well below the observed curve. The principal model fluctuations arise in the "ARIMA BASE" curve, as previously discussed, and are not due to sports. The added sports terms essentially restore the deficit created by the lowered ARIMA base. In this way, the enrollment increases attributed by the PSG model to sports alone are, on average, 890 students greater than the actual total enrollment increases that occurred due to all causes. We also find that
the difference between the observed curve and the ARIMA base, that is, the component that PBG attributes to sports, *is not substantively correlated with the sports data*. Again, the net effect of the PBG model, as indicated in the graphs, is that the PBG model systematically overestimates the enrollment changes at Western. The predicted curve lies systematically above the observed curve, and the corresponding residuals are systematically positive.

This was the point at which PBG noted that the inclusion of enrollment changes at other Kentucky colleges and universities provided no additional explanatory power in their model. This statement is perhaps misleading, since the ARIMA process has apparently filtered out the closely correlated effect of variations in the statewide pool of potential students, preventing its detection. Since the PBG model already predicts more enrollment increase than occurred, there is no portion of the increases remaining to relate to other effects. Besides being a poor representation of the actual enrollment changes at WKU, the PBG model also fails to find the most significant factor, the connection with statewide enrollment changes.

As discussed in the Appendix, a multiple linear regression analysis provides a more straightforward approach to the detection of possible correlations between changes in WKU enrollment on the one hand, and statewide enrollment changes and sports data on the other. Preliminary analysis (PCOR in the Appendix) demonstrates that there is no significant correlation of WKU enrollment changes with any of the sports factors. Of the factors listed above, the only factor showing a significant correlation with changes in WKU enrollment is the total change in enrollment at all other Kentucky colleges and universities.

In the graphs below, we compare the observed changes in WKU enrollment with the predictions of a correlation model (designated CORR in the Appendix) which is based solely on the one factor with demonstrated significance in the data set: enrollment changes across Kentucky.
Even this simple model provides a better representation of enrollment changes at Western than does the PBG model. It satisfies, better than the PBG model, the criteria for a good statistical model given by PBG [PBG, p.16]. The CORR model is a good statistical description of the observed data, having effectively random residual (differences between predicted and observed values) with a mean of zero. Thus the CORR model does not contain the systematic errors of the PBG model. In the Appendix, it is also shown that the CORR model is stable over the entire data set; regression coefficients calculated using only the first half of the time period predict the behavior during the second half as precisely as the regression for the full set. The CORR model also accomplishes a minimization of the summed squared residuals (least-squares optimization), while the ARIMA-based PBG model does not.

The random residuals in the CORR model are uncorrelated with WKU sports records. They represent the combined variations due to factors that have not been included in the model, such as recruiting efforts, admissions policies, inducements for students from neighboring states, and fluctuations in Western's retention and graduation rates.

In order to estimate the effect of sports performance on enrollment that would be allowed by the data if the sport having the highest correlation with enrollment changes actually had a statistically significant correlation, we have included in a regression model the sports variable with the highest (though still statistically insignificant) correlation: men's basketball. The result is an average increase of 62 students per year, which is about equivalent, on the scale of the graphs, to the width of the line used to plot the observations. It is important to realize that this is a number that would estimate the average enrollment increase related to men's basketball, if the record of the men's basketball team were significantly correlated with WKU enrollment changes -- it is not. The figure merely represents an upper limit to admissible sports effects, which are actually undetectable in the data. There is no statistically significant effect of sports on WKU enrollment.

PBG also give an ordinary least squares (OLS) model for the total levels of WKU enrollment [PBG, p.19], which they suggest gives results that are in agreement with the ARIMA difference model predictions. Their inclusion of fitted terms for the previous two years of total WKU enrollment results in a digital filter that is apparently equivalent in effect to the ARIMA process in their model for enrollment changes. The model is strongly auto-regressive, since most of the current level arises from the previous level, plus the previous change: 1.08 Enroll_{t-1} - 0.33 Enroll_{t-2} = 0.75 Enroll_{t-1} + 0.33(Enroll_{t-1} - Enroll_{t-2}). The new-found additional dependence on enrollment levels in other Kentucky schools is in error. The value should be about one-tenth of the quoted value (otherwise the model makes predictions that are thousands of students too high). This correlation is only marginally significant (2σ), and the sports correlations are also only marginally significant, at approximately 2.5σ levels. The 97.9% explained variance is due almost entirely to auto-regressive effects in the model: 97.1% is explained if the sports terms are omitted from the OLS process. A comparison of trends in levels of WKU enrollment and statewide enrollment (see graph in Appendix) suggests that Western is in a relative decline, which may relate to the steadily decreasing buying power of program operating budgets during the period when sports deficits have continued to increase.

In summary, we note the following conclusions, based on analysis of the available statistical facts, regarding the lack of support in the data for the hypothesis that Western's intercollegiate sports performance contributes to increases in general enrollment and associated increases in revenues:

- The PBG model is a poor representation of the actual enrollment changes at Western Kentucky University. It also fails to detect the major factor relating to WKU enrollment changes.
- The only significant factor yet identified as correlated with the observed change in WKU enrollment is the change in enrollment throughout Kentucky.
- There is no significant correlation of WKU enrollment changes with WKU football or men's basketball.
- There is no significant statistical support or basis for the notion that Western's intercollegiate sports performance affects Western's enrollment.
A FINAL POINT

Finally, the authors missed the most important issue that has been raised in the discussions about athletic spending and a major focus of the Vos report. The authors did not test the significance of ATHLETIC SPENDING on enrollment. They say that since, in their view, football and basketball success increases enrollment, WKU should continue to spend large amounts of funds on sports programs and continue to spend more on sports programs than the revenues received. The difference is taken up by the general funds of the university.

An important consideration is whether the university should manage the sports program so that the expenditures on athletics are significantly greater than the intercollegiate revenues, so that the excess has to be taken out of the general revenues of the university. The central issue is how the general funds of the university should be allocated: What proportion should go to sports and what proportion should go to the educational function of the university? A question to be answered is whether the excess expenditures in athletics are justified given (1) the limited financial resources of WKU and (2) the primary educational mission of the university. Aside from the impact of athletics on enrollment, should the university continue to subsidize athletics when funds are needed for faculty salaries, equipment and physical plant maintenance? This is a concern not only of the faculty, the students and the administration of WKU, but also of the taxpayers of the commonwealth. The Vos report was concerned with the allocation of funds to athletics in relation to the academic side, not with cutting out the sports program. The PBG report does not address this. With the capacity of the university being at least close to full, a financially well managed sports program would probably not discourage students from attending WKU, but would free funds that the university desperately needs for its primary mission: to educate the students who attend Western Kentucky University.