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THE BEST BUSINESS SCHOOLS: A MARKET BASED APPROACH

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ABSTRACT

We present a new methodology for ranking business schools. Unlike previous rankings based on subjective survey responses (from CEOs, business school deans, recruiters, or graduates), our approach uses data derived from the labor market for new MBAs. We adjust programs' salaries for the quality of entering students in an attempt to distinguish value added from the quality of incoming students. We then rank programs according to value added. Our results are rather surprising. While four of our top five programs are also labelled as top programs in other rankings, ten of our top twenty are previously unranked. By emphasizing program value added, our procedure identifies several programs that have been overlooked by other rankings since they do not recruit the very top students. We explore the determinants of our value added and student quality measures and find that connections to the business community are positively related to value added, while academic research and high faculty salaries are more strongly associated with student quality. We also find that tuition is better explained by our measure of value added than raw salary, suggesting that programs charge according to value added.

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The past few decades have witnessed tremendous growth in the training of MBAs. The number of MBAs awarded annually has risen from 5,000 in 1960 to more than 70,000 in 1989.[1] Over 650 schools in the country now offer an MBA degree. Demographic changes suggest that this enrollment growth will not continue in the future.[2] Sensing a shakeout coming in the decade ahead, business schools are strenuously competing to achieve or maintain top rankings as means of survival. This has necessarily focused attention on the process of ranking business schools.

Previous rankings of business schools have been constructed using a variety of sources and methods. Rankings have been based on interviews with CEOs, business school deans, recruiters, and graduates. In 1986, Business Week (BW) published a ranking based on interviews with 486 top executives. In 1987, U.S. News & World Report published a ranking based on interviews with 131 deans. In 1988, BW published a widely publicized ranking reflecting both the views of recruiters and business school graduates. These rankings differ significantly because of the differing criteria used by each constituent group to evaluate business programs.

In this paper, we present a new methodology for ranking business schools. Unlike previous rankings, our approach does not use subjective responses from various constituent groups. Rather, we use data derived from the labor market for MBAs.[3] Our approach can be viewed as a modification of the simple method of ranking by average starting salary. We standardize salaries for the quality of the students entering each program in an attempt to isolate the program's value added. A basic goal of our paper is to distinguish the quality of the program from the quality of its incoming students. Our results are rather surprising. While four out of our top five programs are also labelled as top programs in other rankings, ten out of our top twenty program are previously unranked. By

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[1]See p. 93, Porter and McKibbin (1988) and Barrons (1990).

[2]See Byrne (1993), chapter 1.

[3]To use a sports analogy, each year there is considerable interest in which college football team is the best in the country. The current method of resolving this issue is through polls by sports writers. An alternative which is often suggested is a ranking based on a post season tournament. We view the labor market for MBAs as the playing field where business programs compete, and use this rather than taking polls of deans (coaches), recruiters (scouts), or players (graduates).

emphasizing program value added, our procedure identifies several programs that have been overlooked by other rankings since they do not recruit the very top students.

We make several other contributions to the school ranking debate. First, we take the study of MBA rankings a step further by examining the determinants of a school's ranking. For example, how essential are academic research, faculty salaries, and alumni networks to a program's success? We present regression results which assess the contributions of various characteristics of business programs to a school's ranking. Second, we test our measure of value added by asking whether it - or starting salary of graduates - better explains tuition. Finally, because our evaluation is a by-product of statistical estimation, we can report measures of precision for our rankings. Through simulation we determine the frequency that a school is ranked in the top 5 and top 20. This allows us to report confidence intervals for these classifications.

1. Business School Data

Data for this study come primarily from a survey conducted by the authors. Our survey, sent to deans at 85 business schools, requested information about the MBA class of 1991.[4] We sought information about students' backgrounds, their immediate post-MBA job placement, and the characteristics of the MBA programs. We received 49 responses for an overall response rate of 58 percent, although response rates vary significantly across requested data items. Relevant survey information on student backgrounds included GMAT (43 responses), undergraduate GPA (43), percent of students with advanced degrees prior to business school (30), percent with full-time work experience of greater than a year (43). We also asked about the number of applications (38) and acceptances (34) and nonresident tuition (42).

[4]We chose programs two ways. First, we selected programs designated as "top" programs in the business press, e.g. Byrne (1991), Stuart and Stuart (1990). Second, we included the major state school in most states lacking a top program.

Requested placement information included mean starting salaries, as well as the distributions of placements by occupation (finance, marketing, consulting, operations, accounting, general management, and other), by industry (manufacturing, services and nonprofit), and by region (by four census regions and foreign and by major cities, see below). We supplemented our survey using the secondary sources listed in appendix A1. The data set we ultimately use for analysis covers 63 MBA programs.[5] Summary statistics are provided in Table A1.

2. Measuring Value Added

Two principles guide our ranking procedure. The first principle is that rankings should be based on measurable criteria that are comparable across programs. BW's widely cited rankings fail to meet this innocuous-sounding criterion. Their rankings are based in part on a survey of graduates in which respondents rate their own programs on a scale from 1-10 according to 30 criteria. As an example, question 1 asks: "To what extent did your MBA experience fulfill or fail to meet your expectations of what a good program should be?" The reply to this question will be comparable across programs only if each program's students have, on average, identical expectations. This would arise, for example, if students were allocated randomly to MBA programs; but, this clearly is not the case. Expectations and other student characteristics vary across programs making graduate ratings of their own MBA experiences incomparable.

The second principle is that rankings should be based on "outputs" rather than "inputs."[6] A difficulty in devising a ranking system is the lack of consensus on what business programs should be producing. In this paper, we focus on the degree to which business programs are successful in

[5]We have mean starting salary data on 63 programs. Of these 63 programs, we are missing one program's GMAT, we are missing the percent of students with advanced degrees for two programs, and we are missing the selectivity variable (the ratio of acceptances to applications) for two programs. Rather than lose these observations, we impute the missing values by regressing each of the five explanatory variables in Table 2 on the other four, then solving for the missing values.

[6]This distinction can be difficult to make in practice. For example, academic research can be viewed as an output of a business program as well as an input into the training process of MBA students.

producing high-salary jobs for their graduates. Given a competitive labor market for MBAs, salaries will reflect the willingness of employers to pay for the attributes embodied in a program's graduates.[7] A program which attracts high quality students may generate high salaries for its graduates without adding value to them. To isolate a program's value added to the students, we standardize the salary data for the quality of the program's incoming students.[8]

2.1 Adjusting Salary by Region, Occupation and Industry

Reported salary figures reflect regional differences in cost-of-living as well as wage differentials based on occupation and industry (including whether the job is in the non-profit sector). To make our salary data comparable across programs, we adjust starting salaries using school-specific deflators which reflect each school's regional and occupation/industry placement composition.

To control for regional cost-of-living differentials, we use the Bureau of Labor Statistics (BLS) intermediate income urban cost-of-living budget data (BLS 1982). These data indicate the cost of purchasing a common basket of goods across twenty-four major metropolitan areas, as well as an overall urban area average. We delete from the budget amount the component due to personal income taxes. The resulting budget figures are normalized by the overall urban average to yield an index value for each city.

We compute four regional index values using the population-weighted average of the indices for the cities in each region. The BLS last produced budget data for 1981. We update the index to 1990 using the CPI Urban Wage Earner index (1982-1984=100) (BLS 1991). This index gives the current cost-of-living in each of these cities relative to the base period. We compute school-specific

[7]We acknowledge that starting salaries are an imperfect measure of the labor market performance of a program's graduates. No information is provided on the growth rate of earnings on the job or on the expected job duration. Data limitations, however, prevent us from using a measure of the present value of career earnings.

[8]The methodology we use is similar to that used in the urban economics literature to construct quality of life indices for metropolitan areas. See for example Rosen (1979), Roback (1982), and Gyourko & Tracy (1991). The issue of "cream-skimming" arises in many other contexts. See Cragg (1993) for an application to performance evaluation in the government job training programs.

cost-of-living indices using the city and regional distribution of their graduates' placement. The index is calculated as a placement-weighted average of the city and regional cost-of-living indices. The resulting regional salary deflators vary between a low of 0.91 and a high of 1.13.

Business schools also differ in the occupations and industries chosen by their graduates. Some programs send a substantial fraction of their graduates to work in high-paying consulting firms, while other programs place a substantial fraction of graduates in low-paying nonprofit institutions. Whether we should adjust a program's average salary for occupation and industry depends on the determinants of the occupation/industry salary structure for MBAs. If the salary structure reflects ability and skill differences of the MBAs hired into each field, then MBA graduates choosing high-salary occupations/industries would have earned high salaries regardless of their choice. In this case, we should not adjust salaries for occupation and industry. On the other hand, salary differentials may reflect compensation for job attributes such as stress and average hours that systematically vary across jobs in different occupations and industries. In this case, we need to adjust the average starting salaries for each school's occupational/industry placement composition.[9]

Identifying the extent to which the MBA salary structure reflects compensating wage differentials would require data on job attributes for MBA jobs disaggregated by occupation and industry. We do not have such data. In light of this, the best we can do is to estimate occupation/industry wage differentials adjusting for self-selection based on the observed ability of the MBAs. To do this requires micro data on MBAs which identifies the individual characteristics that we use to predict student quality.

We obtained five years of data from a leading business school on starting salary, occupation, industry, GMAT, age, prior work experience, and gender. Using this data we regress each MBA graduate's starting salary on a set of individual characteristics, class year indicators, and occupation/industry indicators. The results, in Table A2, provide some evidence on whether selection on observed ability affects the occupation/industry salary structure for MBAs. The regression in

[9]See Dickens and Katz (1987), Krueger and Summers (1987), and Murphy and Topel (1987) for a discussion of the determinants of the overall occupation/industry wage structure in the U.S..

column (1) includes observable measures of ability while the regression in column (2) omits these controls. The resulting occupation/industry wage differentials are virtually identical in the two specifications.[10] Our data suggest that self-selection based on observed ability is not prominent in the MBA labor market. However, the occupation/industry wage differentials estimated in specification (1) may still be biased from selection on unobserved ability. Addressing this issue would require panel data which follows MBA graduates through their future job changes, data which are unavailable.

These results suggest that occupation/industry salary differentials depend primarily on job, rather than student, characteristics. Hence, we use the estimated occupation/industry wage differentials from specification (1) of Table A2 and each school's occupation/industry placement profile to construct school-specific occupation/industry deflators. We combine the regional and occupation/industry deflators into an overall salary deflator which we use to adjust starting salaries across programs. Table 1 gives the top 20 schools in our sample sorted by adjusted average starting salary. In addition, we list the unadjusted starting salaries and the salary deflators. The adjusted salary distribution is more compressed than the unadjusted salary distribution. The standard deviation of adjusted salary is $8,476 while the standard deviation of unadjusted salary is $10,511.

2.2 Adjusting for Student Quality

We now turn to standardizing the output measure (adjusted salary) for the quality of inputs (incoming students). Our approach is to weight a variety of student characteristics into a single index of student quality. After identifying a set of characteristics which reflect underlying student quality differences, we assign relative weights again appealing to the labor market. We weight each characteristic using its coefficient from a regression of adjusted average starting salary on average

[10]The Chi-square test for the equality of the occupation/industry wage differentials in the two specifications is 9.74, which has a probability value of 0.20.

Table 1: Adjusted Salary Top 20

	1991 BW Ranking	Salary Ranking	Adjusted Salary Ranking	Salary Deflator
Stanford University	5	1	1	1.10
Harvard University	3	2	2	1.14
University of Pennsylvania	2	3	3	1.08
University of Chicago	4	4	4	1.08
University of Virginia	14	5	5	1.04
Northwestern University	1	6	6	1.04
Columbia University	8	7	7	1.11
Duke University	13	10	8	1.03
MIT	11	8	9	1.13
University of Michigan	7	14	10	1.01
Cornell University	16	11	11	1.06
UC - Berkeley	19	13	12	1.05
University of North Carolina	12	17	13	1.01
Dartmouth College	6	9	14	1.14
Carnegie Mellon	9	15	15	1.07
Rice University	NA	24	16	0.95
UC - Los Angeles	10	18	17	1.05
New York University	17	12	18	1.13
Yale University	NA	16	19	1.09
University of Maryland	NA	26	20	0.95

Notes: Salary deflator reflects each school's cost-of-living, occupational, and public/private sector placement composition.

student characteristics. Our resulting measure of "student quality" is the fitted value from this salary regression, while our measure of a school's "value added" is the résidual from this regression.[11]

The regression used to construct our student quality index is given in specification (2) of Table 2. Summary statistics and information on sources are given in Table A1. The two most important student quality variables are the average GMAT and the percent of students with at least a year of full-time work experience. The marginal effect for GMAT turns positive at a score of 546, which is slightly above the minimum score observed in our sample. Business programs whose students score higher on the GMAT and who have more prior work experience have significantly higher starting salaries upon graduation, and are therefore better inputs into the MBA training process. Figure 1 provides simple plots of our adjusted starting salary measure and the GMAT and work experience for each school in our sample. Each of these determinants is clearly positively correlated with adjusted salary.

The three other coefficients reported in the specification (1) of the quality regression have the expected sign but are not precisely measured. Controlling for the average GMAT score of the incoming class, an increase in the average undergraduate grade point average has a positive but imprecisely measured effect on starting salaries. The adjusted salary - and, we infer, quality of the incoming students - is higher when a greater fraction enter with a graduate degree. Finally, the quality of the incoming students may be higher as a result of a wide applicant pool from which to select.[12] This is supported by the negative coefficient on the schools' ratio of acceptances to applications. We construct our student quality and value added measures using the fitted values and residuals from specification (2), which omits the insignificant variables.

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[11]For a similar analysis of the determinants of the average starting salaries of lawyers see Table 1 of Ehrenberg (1989).

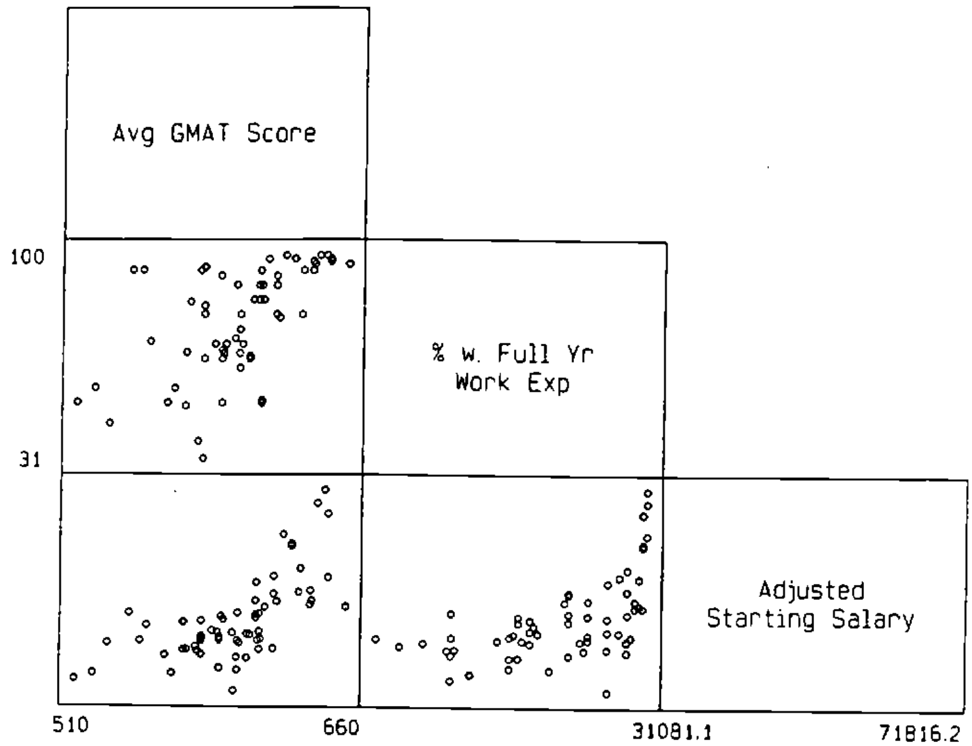
[12]Admissions offices have more information available to them on which to base their decisions than is reflected in the variables reported in Table 2. If on average this information is useful for screening out the less qualified candidates, then average quality among the admitted students should be increasing in the selectivity of the admissions process.

Table 2: Regression of Salary on Student Characteristics

Variable	(1)	(2)
Constant	470,987 (222,717)	521,811 (179,046)
Gmat	-1,632.50 (758.07)	-1,791.81 (607.84)
Gmat squared	1.49 (0.65)	1.64 (0.52)
Percent with at least one year of full time work experience	106.99 (55.16)	101.10 (49.71)
Undergratuate grade point average	2,281.78 (6,655.90)	
Percent with a graduate degree	35.73 (179.27)	
Ratio of acceptances to applications	-16.13 (65.86)	
Number of Observations	63	63
R-square	0.565	0.563

Notes: Standard errors are given in parentheses. We measure student quality (value added) using the fitted values (residuals) from specification (2).

Figure 1: Scatter Plots of Adjusted Salary and Student Characteristics



Notes: The axis of each plot are given by reading up and over to the right to the respective variable labels.

2.3 Is Our Value Added Measure Reasonable?

Our measure of value added, the residual from the adjusted salary regression, provides a measure of how unexpectedly high - or low - a program's adjusted starting salary is, given the observed characteristics of its incoming students. We interpret this residual as the relative enhancement of starting salaries that is induced by the business program itself. This interpretation attributes all differences in salary, conditional on student characteristics, to differences across programs in value added. Alternatively, residual post-MBA salary differences may reflect residual pre-MBA salary differences. That is, our measure of value added may be biased due to the nonrandom assignment of students to business programs conditional on observed characteristics in our data which results from the admissions process.

A program's adjusted salary might be high, given its students' average GMATs and work experience, because business programs may admit candidates on the basis of characteristics which lead to high starting salaries, and are observed to the admissions office but unobserved in our data. For example, some programs may interview candidates and select those with charisma. If charisma enhances salaries, then such programs' adjusted salaries will reflect not only value added by the MBA program but also screening by the admissions office.[13] As a result, our value added measure, the post-MBA salary residual, will partly reflect pre-MBA unobserved salary heterogeneity in addition to value added by the program.

The natural approach to this problem is to measure a program's value added by comparing students' pre- and post-MBA salaries. Limited longitudinal data allow us to explore this method. We have pre- and post-MBA salary data for 35 schools which we can use to calculate the change in salary, $\Delta y = y_{post} - y_{pre}$.[14] The use of Δy as a measure of program value added would be valid if

[13]Our inclusion of an admissions selectivity variables partially avoids this problem, but the problem may linger given the inherent difficulty of measuring selectivity across different self-selected applicant pools.

[14]Pre and post-MBA salary data for the class of 1992 are from Byrne (1993). No information is available to adjust the pre-MBA salary for regional and industry/occupational differences in admission profiles. Consequently, we use unadjusted pre- and post-MBA average salaries in the analysis.

there were no complementarities between student quality and program quality in the production of business education.

To explore this issue we estimated the following regression:

$y_{post} - y_{pre} = X\delta + \eta$, where X contains the student characteristics used above to explain the level of post-MBA salary. Here, $X\delta$ is intended to capture the degree of complementarity in the business education production function while η is the component of the change in salary that is independent of student characteristics.[15] We reject the hypothesis that $\delta = 0$ (for instance, students at programs with higher average GMATs experience higher average salary growth). For this reason, we prefer η over Δy as a measure of program value added derived from the longitudinal data.

How similar are the rankings resulting from η and the post-MBA residual, ϵ_{post}, when both are calculated from the same longitudinal salary data? Figure 2 plots η against ϵ_{post}. The two measures are highly correlated (0.88), and the resulting rankings are very similar. Appendix Table A4 presents the top 20 business schools (of the 35 programs for which pre- and post-MBA salary data are available) based on the post-MBA salary residual ϵ_{post} and based on η. We conclude from this evidence that the rankings resulting from our approach are not driven by the mistaken attribution of unobserved differences in pre-MBA salary to our value added measure.

2.4 Student Quality Rankings

Table 3 presents the top twenty schools in our sample sorted by our measure of student quality (the fitted value from a regression of adjusted salary on student characteristics). Our estimates indicate that Yale's School of Management attracts the best students.[16] Fifteen of the top 20 schools

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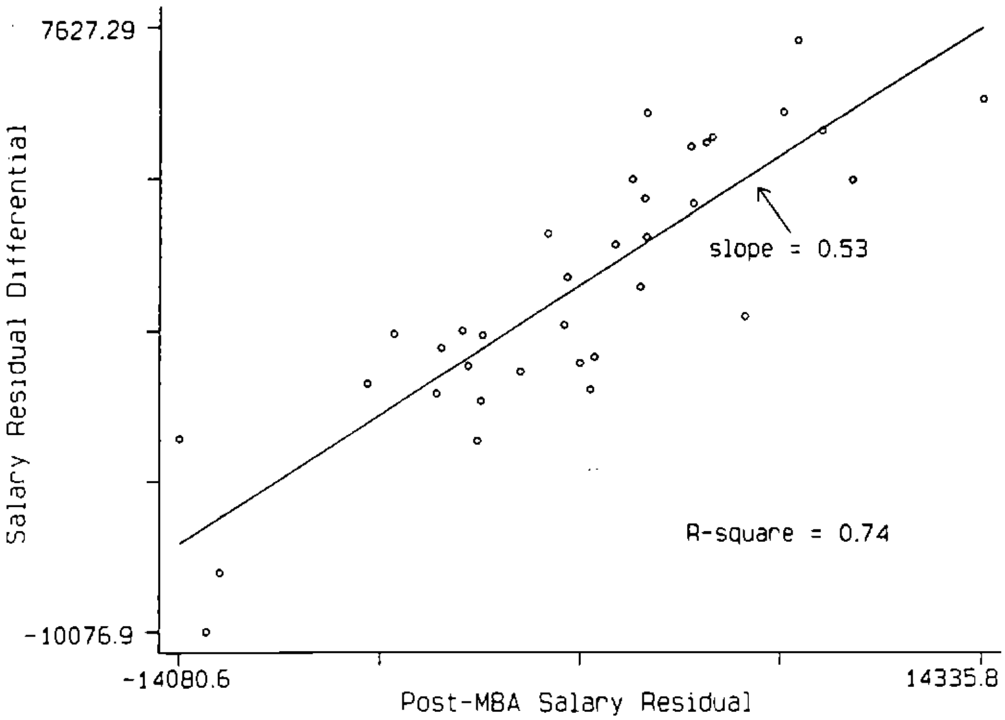
[15]Note that η is arithmetically identical to the difference between the post- and the pre-MBA salary residuals. If we estimate $y_{post} = X\beta_{post} + \epsilon_{post}$ and $y_{pre} = X\beta_{pre} + \epsilon_{pre}$, then $\delta = \beta_{post} - \beta_{pre}$ and $\eta = \epsilon_{post} - \epsilon_{pre}$.

[16]Harvard does not require the GMAT in its application. As a result, Harvard does not report an average GMAT score for its students. To keep Harvard in the sample, we used a GMAT score determined by a survey of Harvard students in 1991. See U.S. News, April 29, 1991. This imputation

Figure 2: Comparison of Alternative Value Added Measures



Notes: Class of 1992 pre and post-MBA salary data from Byrne (1993).

Table 3: Student Quality Top 20

	1991 BW Ranking	Adjusted Salary Ranking	Student Quality Ranking
Yale University	NA	19	1 (0.0)
University of Pennsylvania	2	3	2 (0.1)
MIT	11	9	3 (0.2)
Stanford University	5	1	4 (0.1)
Harvard University	3	2	5 (0.0)
Dartmouth College	6	14	6 (0.1)
UC - Los Angeles	10	17	7 (0.2)
Cornell University	16	11	8 (0.1)
Columbia University	8	7	9 (0.2)
University of Virginia	1	6	10 (0.5)
Northwestern University	14	5	11 (0.8)
UC - Berkeley	19	12	12 (1.3)
University of Chicago	4	4	13 (0.5)
Duke University	13	8	14 (0.6)
University of Washington	NA	49	15 (0.5)
New York University	17	18	16 (1.4)
Rice University	NA	16	17 (1.6)
University of North Carolina	12	13	18 (1.4)
University of Minnesota	NA	42	19 (1.4)
Georgetown University	NA	31	20 (0.7)

Notes: Student quality is measured as the fitted value from the regression in specification (2) of Table 1. Standard errors are given in parentheses and are based on 100,000 simulations.

based on student quality were ranked in BW's top 20. Not surprisingly, 17 of these schools were also in the top 20 based on adjusted salary.

The student quality ranking is based on estimation. Sampling variation in the underlying regression coefficients will produce variation in the resulting rankings. Thus, we can compute measures of precision associated with each rank. The standard deviation of a school's rank was estimated using simulation methods. We generate new coefficient estimates using the estimated distribution of the coefficients derived from our quality regression. For each new set of coefficients, we recalculate the ranking. We replicate this process 100,000 times, which produces a distribution of ranks for each school. The standard deviation of this distribution is reported in the table.

3. Top Business Schools

We are now ready to present our value added rankings of the top business schools. Recall, we measure each school's value added using the school's residual from the adjusted salary regression reported in specification (2) of Table 2. Table 4 presents the top twenty business schools based on our methodology. Stanford University ranks highest, while Harvard, Chicago, Virginia, and Wharton round out the top five. Except for Virginia, each of these schools was also in the top 5 of the BW ranking.

Our methodology produces some surprises of inclusion in, and exclusion from, the top twenty. For example, Dartmouth, Columbia, and UCLA are all in the BW top 10, yet do not appear in our top 20. These schools rank very high on our student quality measure, but do not produce commensurately high starting salaries. Consequently, our methodology assigns a low value added to these programs. In contrast, Oklahoma State, New Mexico, and Wake Forest are in our top 10, but are not in the BW top 20. These schools are in the opposite situation; their graduates earn moderately high starting salaries despite having relatively modest student characteristics. The appearance of such different programs in our top 20 highlights the difference between our value added approach and the

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should be kept in mind when interpreting the rankings in this paper.

Table 4: Value Added Top 20

	1991 BW Ranking	Adjusted Salary Ranking	Student Quality Ranking	Value Added Ranking	Simulated Percent Top 5	Simulated Percent Top 20
Stanford University	5	1	4 (0.1)	1 (0.2)	100.0	100.0
Harvard University	3	2	5 (0.0)	2 (0.4)	99.9	100.0
University of Chicago	4	4	13 (0.5)	3 (0.6)	99.9	100.0
University of Virginia	14	5	10 (0.5)	4 (1.2)	83.2	100.0
University of Pennsylvania	2	3	2 (0.1)	5 (2.8)	57.0	99.6
Northwestern Universiy	1	6	11 (0.8)	6 (1.4)	21.3	100.0
University of Michigan	7	10	22 (1.0)	7 (2.2)	0.1	100.0
Oklahoma State Univ	NA	28	26 (0.8)	8 (1.7)	3.3	100.0
Universiy of New Mexico	NA	22	47 (9.8)	9 (6.7)	13.5	88.0
Wake Forest University	NA	29	56 (2.8)	10 (3.0)	3.3	99.1
Brigham Young University	NA	40	63 (4.0)	11 (5.5)	12.1	93.7
Vanderbilt	NA	24	43 (3.7)	12 (1.6)	0.0	100.0
Duke University	13	8	14 (0.6)	13 (3.1)	0.0	98.0
University of Tennessee	NA	47	62 (4.1)	14 (7.9)	5.6	74.4
Southern Methodist Univ	NA	27	45 (3.1)	15 (3.2)	0.0	90.7
Purdue University	NA	26	41 (2.7)	16 (1.6)	0.0	99.5
University of Texas - Austin	18	21	34 (7.9)	17 (6.0)	0.1	71.7
University of Oklahoma	NA	48	54 (1.6)	18 (6.0)	0.7	66.3
Carnegie Mellon Univ	9	15	24 (0.7)	19 (3.4)	0.0	63.6
University of Maryland	NA	20	28 (1.9)	20 (2.8)	0.0	55.3

Notes: Value added is measured as the residual from the regression in specification (2) of Table 1. The standard errors are given in parentheses. The standard errors and percent top 5 and top 20 are based on 100,000 simulations. The full set of rankings are available upon request from the authors.

traditional rankings. In particular, our results suggest that existing rankings implicitly assign a large weight to the quality of students when evaluating the quality of the programs themselves.

Table 4 also reports two columns indicating the percentage of times in 100,000 replications that a school is in the top 5 and top 20. This allows us to calculate confidence intervals for these two classifications. For example, three (fourteen) schools are in the top 5 (20) in at least 90% of the simulations. In contrast, eight (twenty seven) schools are in the top 5 (20) in at least 10% of the simulations.

Two observations are in order. First, it is important to recognize that the value added estimates, and associated rankings, are based on the current allocation of students to programs. Thus, our rankings should be understood to reflect the value added currently conveyed to the students at each of the programs, not the value added that would unconditionally be transmitted to any students at these programs. Second, while the ranking of any particular program can be distorted by measurement error (particularly in salary), the overall pattern of rankings, with traditional top schools near the top and less well-known programs completing the top 20, is not driven by measurement error.

4. Determinants of Program Quality

Previous approaches to ranking business programs do not attempt to determine the factors contributing to their overall ranking. Yet, this is an important matter for investigation. Deans are continually faced with decisions affecting the scope and content of their programs, and the effect of these decisions on the performance of the programs is relevant to these decisions. We investigate this issue by examining the relationship between schools' value added and a set of program characteristics, including the quality of the alumni network, faculty research quality, and faculty salary. Data availability limits the extent to which we can explore other program characteristics.

To explore the determinants of program quality, we regress our measure of value added on program characteristics. There are two qualification to keep in mind as we proceed. First, given the complementarities between student and program characteristics that we demonstrated earlier, there is no unique decomposition of starting salary into student quality and value added. Second, we have adopted a two-step estimation strategy in which we first regress starting salary on student characteristics, and then we regress the salary residual (value added) on program characteristics. If student and program characteristics were orthogonal in the data, then this two-step procedure would produce the same coefficients as a pooled estimation. The data, though, reject this orthogonality.[17] While the two procedures are statistically distinct, meaningful differences do not exist. The rankings produced by both methods are virtually the same and the qualitative findings are identical.[18] We prefer the two-step procedure for its methodological simplicity.

The first program characteristic we include is a measure of each school's alumni network. Specifically, we calculated the number of **Business Week 1000** firms with CEOs from each business program.[19] Schools with more connections to top firms, as measured by the training of their CEOs, may have an advantage in placing their recent graduates. Alternatively, this variable may simply measure current success in terms of past success. Harvard is a outlier according to this measure with 79 CEOs to its credit. Stanford ranks second with 23 CEOs. We present these regressions with and without Harvard in the sample to check for robustness of the results.

We control for two characteristics of the business school's faculty. The first is a proxy for the research intensity of the faculty. Unfortunately, we do not have any direct measure of research intensity for all of the schools in our sample. What we can measure is the research output of the economics department in the same university. Limited available evidence indicates that this is as an

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[17]The specification test for the equality of the coefficients on the student quality variables estimated with and without the program characteristics results in a chi-square statistic of 20.4, which is highly significant.

[18]Let X represent the students characteristics used above in the adjusted salary regression, Z represent the program characteristics, and Y our adjusted salary data. If we regress Y on X and Z, then the residual $\epsilon = Y - X\hat{\beta}_x$ produces virtually the same ranking as ϵ_{post} used above.

[19]See Roman, Mims, & Jespersen (1991).

adequate proxy.[20] The measure used is the citations per faculty taken from Liebowitz & Palmer (1988). The data are normalized as a percent of the level of citations at the University of Chicago. The second characteristic is the level of faculty salary. Specifically, we include a dummy variable which takes a value of one for schools whose faculty salaries are rated "well above average" based on the AAUP rating system for their category of institution. This classification is taken from Barron's (1990).

Table 5 presents the results from regressions of value added and student quality on program characteristics. Since the dependent variables are estimated from a previous stage, we estimate this regression using weighted least squares. The weight applied to each school is the precision of the estimate of the dependent variable.[21]

The results in Table 5 indicate that business networks have a positive impact on both value added and student quality, significant in the case of value added. When we exclude Harvard, then the marginal effect of business networks more than triples in magnitude. With Harvard excluded, each additional BW 1000 CEO among a school's alumni is associated with over a $700 increase in our measure of value added. A standard deviation change in our business network variable (3.8) leads to a $2,888 increase in value added, or roughly one half of the standard deviation of value added in the sample. The impact of business networks on student quality is roughly half the magnitude of its effect on value added.

Research intensity and high faculty salaries have weak and insignificant impacts on value added, but stronger and more significant effects on student quality. Schools paying high faculty salaries attract on average students that are over $4,000 better in our quality measure, roughly two-thirds a standard deviation of student quality in the sample. Similarly, increasing a school's research

[20] Paul MacAvoy provided us with citation data for eleven of the top research business schools (see MacAvoy (1989)). The correlation with the citation data from the same economics departments is 0.66.

[21] The weight used for the value added regression is $V(\hat{e}_i)^{1/2} = [\,\hat{\sigma}^2(1-h_{ii})\,]^{1/2}$, where $\hat{\sigma}^2$ is the estimated residual variance and h_{ii} is the ith diagonal element of the Hat matrix. The weight used for the student quality regression is $V(\hat{y}_i)^{1/2} = [\,\hat{\sigma}^2 h_{ii}\,]^{1/2}$.

Table 5: Correlates of Value Added and Student Quality

	Value Added		Student Quality	
Variable	Harvard Included (1)	Harvard Excluded (2)	Harvard Included (3)	Harvard Excluded (4)
Constant	-947.89 (852.95)	-1,010.12 (806.85)	42,377.79 (686.11)	42,350.26 (678.30)
Business Week 1,000 CEO's w. MBA from School	204.54 (71.50)	760.40 (208.02)	87.73 (65.05)	384.53 (201.83)
Research Cits. / Faculty - econ. dept.	25.14 (45.24)	-32.51 (47.39)	108.66 (36.88)	77.05 (41.76)
High Faculty Salary	174.52 (852.95)	-449.49 (1,459.82)	4,679.26 (1,206.60)	4,395.51 (1,206.42)
Number of Observations	63	62	63	62
R-Square	0.183	0.181	0.474	0.467

Notes: Weighted least squares regressions with weights equal to inverse of the standard error of the dependent variable. Standard errors are given in parentheses.

intensity by 17 percentage points (one standard deviation) results in over an $1,800 increase in student quality.

The coefficients on research intensity and faculty salaries reported in Table 5 must be interpreted in light of the other variables being held constant. That is, given a program's business connections, increasing its focus on research and/or moving to the right tail of the faculty salary distribution does not appear to directly contribute to a program's value added. However, research intensity and high faculty salaries may still have an important indirect effect by making it possible for a school to maintain its business network. To investigate this, we estimated the value added specification dropping the BW 1000 CEOs variable. In this case, the coefficient (standard error) on research intensity was 75 (44) and on faculty salary was 616 (1,606). Research intensity, then, does have a positive and marginally significant relationship to value added when we do not control for a school's existing business network.

We would like to briefly describe the results from some alternative value added and student quality specifications that we estimated. As an additional control for teaching quality, we included a variable measuring the percent of classes taught by instructors with Ph.D.'s. This variable was insignificant in both specifications. We also included an indicator variable which takes the value of one if a school makes grades available to recruiters. This grade policy had a positive but insignificant effect on value added, both with Harvard in and out of the sample. In contrast, this grade policy had a sizeable negative effect on student quality that is robust to including or excluding Harvard. Schools that provide grade information are estimated to attract students that are on average $2,000 lower in quality (however the standard error on this estimate is around $1,600). If withholding grades fosters a "cooperative learning environment", then there is weak evidence that this enhances a school's ability to attract better qualified students.

5. You Pay For What You Receive

The last section of the paper explores the issue of what determines the tuition charged by MBA programs. If schools compete for MBA students, then tuition should be an increasing function of the quality of the program. Better programs should be able to collect higher fees from its students. If our value added methodology is sensible, then the a school's value added should have a stronger association with its tuition than does its adjusted salary.

Table 6 gives regressions of tuition on adjusted salary and value added.[22] We include an indicator variable to control for the private status of a school. The first column indicates that tuition for business programs in private schools is higher on average by $6,793. It is interesting to note that this tuition differential remains largely undiminished after we control for either adjusted salary or value added. We also find no evidence of an interaction between private status and the slope of the tuition/adjusted salary or the tuition/value added relationship. The second column indicates that each additional dollar of adjusted starting salary is associated with 14 cents in additional tuition.

We estimate the tuition/value added relationship using instrumental variables. The reason is that value added is an estimated variable. Measurement error in the estimation process will lead to a downward biased estimate of its coefficient. To correct for this, we instrument for value added using the variables reported in Table 5. The results in column three show that each additional dollar of adjusted salary is associated with 44 cents in additional tuition. At the margin, then, tuition has a stronger relationship to what a school offers a student in terms of value added than simply adjusted salary.[23]

Conclusion

In this paper, we present a new methodology for evaluating the performance of MBA programs. The ranking is based on the performance of each school's graduates in the labor market for MBAs. A school's performance is judged by its value added rather than its adjusted salary. Our

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[22]We do not have sufficient information on fellowships by school to standardize the tuition amounts. School's may raise their tuition and also their level of fellowship support in an attempt to price discriminate in their admissions.

[23]Using 1985 data, Ehrenberg (1989) finds a similar tuition differential for private law schools controlling for quality of the law program as indicated by the law school's Gourman score.

Table 6: Tuition Regressions

Variable	OLS Coefficient	OLS Coefficient	IV Coefficient
Constant	7,855 (532)	1,726 (1,880)	8,146 (716)
Private status	6,793 (740)	6,014 (721)	6,305 (1,005)
Adjusted salary		0.144 (0.042)	
Value added			0.436 (0.205)
Number of observations	62	62	62
R-square	0.584	0.639	0.284

Notes: Adjusted salary is the average 1991 starting salary adjusted for each school's cost-of-living, occupational, and public/private sector placement composition. Standard errors are given in parentheses. Value added is instrumented using the specification reported in specification (1) of Table 5.

top seven business programs all have received praise from other rankings. However, our procedure does pick out several schools that are not high salary schools, but deserve credit for adding value to their students. Similarly, several schools with high salaries and high praise in other quarters are poor performers using our methodology. This reflects the fact that they attract exceptionally high quality students who do not receive correspondingly high average salaries. This underscores the fact that our methodology is not simply a relabeling of the underlying starting salary. Further, our results suggest that the existing widely cited rankings implicitly give substantial weight to the quality of a program's students, rather than focusing on the quality of the programs themselves.

We extend the earlier debate by attempting to find variables that are correlates of value added. A school's connections with the business community is a positive force in determining a school's ranking. In contrast, research intensity and high faculty salaries have a stronger impact on the quality of a school's students. Finally, we find that the tuition a program can charge has a stronger connection to the program's value added than to its adjusted salary.

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