RETURNS TO FIELD OF STUDY VERSUS SCHOOL QUALITY: MBA SELECTION ON OBSERVED AND UNOBSERVED HETEROGENEITY

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While a substantial literature has established returns to college major and to school quality, we offer the first such estimates for Master's of Business Administration (MBAs). To control for their nonrandom selection of fields, we estimate the returns to MBA concentrations using both ordinary least squares (OLS) with detailed control variables and including individual fixed effects. We find approximately 7% returns for most MBAs but roughly double that for finance and management information systems (MIS). Thus, MBA area of study can matter as much or more than program quality: only attending a top 10, but not 11-25, MBA program trumped studying finance and MIS at a nontop 25 program. (*JEL* I21, J30, J24)

I. INTRODUCTION

Given the importance of human capital investment, prospective college students and parents must often choose between higher-quality-and-cost and lower-quality-and-cost schools. The considerable literature that has examined this trade-off identifies not only school quality as a principal driver of postbaccalaureate earnings but also students' choice over fields of study.[1] Despite the attention lavished on school rankings, James et al. (1989), for example, conclude that "... college experience variables (especially major) explain more of the variance (in earnings) than measured family background, ability, and college characteristics combined" (252).[2] That is, a prospective baccalaureate student can expect strong future earnings not only by attending a highly ranked institution but also by majoring in a highly rewarded field, such as engineering, the sciences, or business, at a lesser ranked school. Surprisingly, this important conclusion about the trade-off between content and quality has not been generalized to any other postsecondary degree programs, such as associate degrees at community colleges or master's of education, Master's of Business Administration (MBA), law, medical, or PhD programs. The goal of this article is to fill this void in the literature by estimating the returns to both program quality and fields of specialization in the context of graduate education.

Specifically, we estimate these returns for the third most commonly earned postsecondary degree, the MBA (Morgeson and Nahrgang 2008). Prior research has estimated a large drop-off in returns to an MBA beyond the nation's elite programs (Arcidiacono et al. 2008). Because of this, and because MBAs are likely to face significant opportunity costs of moving to

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1. See, for example, Altonji (1993), Berger (1988), Daymont and Andrisanti (1984), Grogger and Eide (1995), James et al. (1989), Loury (1997), Loury and Garman (1995), Monks (2000), Fitzgerald (2000), Arcidiacono (2004), McDonald and Thornton (2007).

2. Similarly, Fitzgerald (2000) finds that higher education experiences, namely, grade point averages (GPAs) and major fields of study, explain more of the variation in 1991 male earnings for the 1980 High School and Beyond sample than do institutional characteristics but that both sets of factors are roughly equally important for females.

ABBREVIATIONS

AACSB: Association of Advance Collegiate Schools or Business
GMAC: Graduate Management Admissions Council
GMAT: Graduate Management Admission Test
GPA: Grade Point Average
MBA: Master's of Business Administration
MIS: Management Information Systems
OLS: Ordinary Least Squares

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attend a more highly ranked program than what may be available locally, estimating the trade-offs between returns to program quality and to fields of specialization is especially important for MBAs. In the data set used in this study, the average MBA student had about 6 yr of full-time work experience, half were married, and 27% had children. However, if family and job ties restrict potential MBA students from enrolling in more highly ranked programs, might they nonetheless be able to earn high wage premiums by specializing their studies in fields with higher returns?

Our study focuses on MBA areas of concentration. In response to competitive pressures and consumer demand, many business schools have offered the opportunity for students to go beyond the core MBA curriculum by tailoring additional coursework toward a particular area.[3] In this way, MBA concentrations mirror the role of undergraduate majors. Unfortunately, to our knowledge, no entity such as the Association of Advance Collegiate Schools or Business (AACSB) or the Graduate Management Admissions Council (GMAC) systematically collects information about the specific courses that constitute areas of concentration by MBA program. The structure and actual courses included in concentrations within MBA programs vary from school to school, akin to differences among undergraduate business programs.[4] However, MBA concentrations typically consist of four to five topical courses, but range as high as seven or more, according to Dierdorff and Rubin's (2008) survey of 576 of the 621 programs in the United States accredited by the AACSB.[5] Perhaps the main distinction between undergraduate and MBA fields of study is that while most U.S. undergraduate business programs offer the full array of standard business fields, that is, general management, finance, accounting, marketing, management information systems (MIS), and international business, MBA areas of concentration, despite their increasing prevalence, are more selectively offered by schools. Furthermore, the presence of areas of concentration does not appear to be correlated with overall school quality, suggesting that the quality of program attended and the choice of focus of study may be two independent drivers of increased earnings among graduates.[6]

Besides replicating the returns to quality-versus-content for an increasingly important and diverse advanced degree, doing so for MBAs offers one chief advantage over existing estimates for collegiate degrees. Among other post-secondary degree earners, only MBA students typically have substantial full-time work experience. The existence of pre- and post-MBA earnings helps solve a perennial obstacle in estimating the financial returns to college education, where the lack of precollegiate full-time earnings prohibits a direct comparison of net returns. Thus, some part of the observed relationship between educational choice and attainment and postgraduation earnings may result from unobserved individual characteristics (Brewer and Ehrenberg 1996; Heckman 1979).[7] Consequently, researchers have used four strategies to identify the wage effect of schooling, that is, to separate the returns to schooling from the effect of observed and unobserved attributes on educational choice and attainment: exclusion restrictions,[8] instrumental variables,[9] sibling and twin data sets,[10] and controlling for selection

3. According to Dierdorff and Rubin (2008), 56% of accredited conventional MBA programs now offer at least one concentration and 93% of those offer at least two. An additional 9% of MBA programs offer entirely specialized degrees.

4. For illustrative purposes only, we offer two current examples of how concentrations are organized. At the Kellogg MBA program (at Northwestern University), a finance concentrator takes Finance II (Finance I is a Core Curriculum requirement) and then three additional finance courses out of six choices. At Duke's Fuqua School of Business, each MBA concentration includes a set of electives from which one chooses six courses—four courses in a focal area (e.g., finance) and two courses from other areas that support the focal concentration (referred to as a "4–2" structure).

5. According to Dierdorff and Rubin (2008), the average number of required courses per concentration varies as follows: accounting, 5.31; finance, 5.2; MIS, 7.55; international business, 3.93; and management, 4.09 (p. 21).

6. For example, in 1993 among 25 leading business programs, the following numbers did not offer the following areas of concentration: accounting, 4; finance, 2; MIS, 10; international business, 11; and marketing, 2 (Segev et al. 1999, 555).

7. Some researchers have attempted to account for self-selection concerns by explicitly modeling the student's choice of the type of institution of higher education to attend (Brewer, Eide, and Ehrenberg 1999; Montgomery 2002, for full- versus part-time MBA programs) or student's choice of field (Arcidiacono 2004; Paglin and Rufolo 1990).

8. Willis and Rosen (1979) rely on exclusion restrictions in a structural model, using income elasticity estimates for selectivity bias to predict the income associated with each field of study for all students.

9. Other investigators have relied on instrumental variables, for example, proximity to colleges or date of birth, to identify the effect of education on earnings (Angrist and Krueger 1991; Kane and Rouse 1995).

10. Twin studies estimate the value of an additional year of education, controlling for family background and common genetic influences (Ashenfelter and Rouse 1998; Berhman and Taubman 1989; Berhman et al. 1994, 1996).

with lots of observables.[11] In the latter approach, to obtain sufficiently detailed individual information over time, researchers use a variety of nationally representative longitudinal data sets on labor market outcomes of distinct cohorts of college graduates.[12] We offer fixed effects as a fifth approach to identify the wage effect of field of study, as Arcidiacono et al. (2008) did for returns to MBA quality.

More specifically, we use two strategies to control for selection into both MBA concentrations and program quality categories. First, we use a selection-on-observables approach by including in the analysis a nationally representative longitudinal data set with a particularly rich set of variables observable to the econometrician. Our second strategy exploits the existence of both pre- and post-MBA earnings[13]—an anomaly among higher education students, because undergraduate, graduate, doctoral, and professional degree seekers typically go directly from one educational program to another.[14] This important feature of the data allows for the use of individual fixed effects in earning regressions, which eliminates time-invariant, individual-specific heterogeneity as reflected in an individual's wages. This strategy may be considered an improvement over the selection-on-observables approach, in that observable covariates, however numerous they may be, imperfectly proxy for the actual factors contributing to both educational decisions and education-independent labor market outcomes. Consider, for example, the comparison of person A, who has more innate ability (or motivation, ambition, etc.) and interest in finance, versus person B, who is otherwise observationally identical but has less such aptitude and preferences for fields of study. Person A is both more likely to select a finance concentration and to achieve greater earnings independent of choosing finance, so a simple cross-sectional comparison (or the use of ordinary least squares [OLS]) would lead to upward biased estimates of returns to the finance field. The fixed-effect specification moves beyond this comparison and instead investigates the "within-individual" variation, not requiring a control group of non-MBAs (or nonfinance concentrators) to identify the effect of studying finance on those who obtain an MBA and choose finance as a concentration.[15]

The data come from the GMAT Registrant Survey, a longitudinal survey of registrants for the Graduate Management Admission Test (GMAT), a standardized examination meant to assess an individual's readiness or propensity for advanced business and management training, which is required by most MBA programs for admission. The survey occurred in four waves from 1990 to 1998, whether or not the registrant ultimately obtained an MBA.

For several reasons, the GMAT Registrant survey is a good source of data to evaluate the returns to MBA fields. First, GMAT test takers comprise a relatively homogeneous group in terms of human capital and career goals. Second, we have good information about scholastic aptitude and quality of education because the survey data are linked to test scores and other data from GMAC records. The surveys also provide a wealth of additional information about individuals, including work experience, earnings, and noncognitive information about individuals, such as self-assessed soft skills that may proxy for self-confidence. Thus, these data provide extensive information observable to the researcher about worker heterogeneity.

Our estimates of the return to MBA areas of concentration suggest average earning gains for most fields of study of around 7% but wage premiums of twice that amount for MIS and finance. Although attending a top 10 program

11. Black, Sanders, and Taylor (2003), for example, identify wage differences associated with college majors by comparing workers with identical demographic characteristics (namely, age, race, and ethnicity, based on data from the 1993 National Survey of College Graduates, NSCG).

12. Examples include the National Longitudinal Survey of the (High School) Class of 1972 (NLS-72) cohort (Arcidiacono 2004; Grogger and Eide 1995; James et al. 1989), the High School and Beyond Longitudinal Study of 1980 Sophomores (H&B-So:1980/1992) cohort (Fitzgerald 2000), or the Baccalaureate and Beyond study (B&B: 93/97) cohort (Thomas and Zhang 2005).

13. At the time of GMAT registration, average work experience among our sample of eventual MBA students exceeded 5.5 yr and over 75% had at least 2 yr of full-time work experience.

14. Boudarbat (2008) examines a rare exception, where 43% of the students in his study of Canadian community college major choice had prior full-time work experience; work experience is coded as a dichotomous variable rather than by quantifying experience or using earnings.

15. That is, the use of fixed effects allows us, in the language of the treatment effects literature, to estimate the average effect of the treatment on the treated. An additional advantage is that it can do so for multiple treatments (i.e., multiple study concentrations or types of MBA programs), whereas other approaches would likely require multiple instrumental variables or exclusion restrictions. Despite the advantages, the fixed-effect framework does require certain assumptions for identification, which are discussed in Section III and, to the extent possible, tested for in Section V.

(according to *U.S. News & World Report* rankings) yielded a 12% wage premium, our fixed-effect estimates suggest that otherwise quality rankings insignificantly affected returns to an MBA. Thus, we find, as with undergraduate education (Fitzgerald 2000; James et al. 1989), that field-of-study returns can trump program quality. Comparing OLS and fixed-effect estimates suggests that some of the OLS estimates of returns are biased significantly due to nonrandom sorting on unobservables into MBA programs and concentrations. In particular, individuals positively select into top-ranked schools and negatively select into studying general management at lower ranked programs.

Given those differential wage gains and sorting into fields of study, we estimate the determinants of concentration choice (both expected and actual) using both multinomial logit and logit analysis. Although a variety of factors predict sorting into MBA areas of concentration, we find that the finance concentration is predicted by a larger set of variables than are any other fields relative to general management (in a multinominal logit model) or relative to all other areas of concentration (in a logit model). Our evidence indicates that quantitative skills sorted students into finance, akin to the findings of undergraduate major sorting by Arcidiacono (2004) and of graduate education field of study by Paglin and Rufolo (1999).[16]

II. DATA DESCRIPTION

We utilize data from the GMAT Registrant Survey, a longitudinal survey of individuals who registered to take the Graduate Management Admissions Test (GMAT), an admissions requirement for most MBA programs. Sponsored by the GMAC, the survey was administered in four waves, between 1990 and 1998.[17] The Wave I survey occurred from April 1990 to May 1991, shortly after test registration but prior to MBA enrollment. Of the 7,006 registrants initially surveyed, 5,885 responded to the first survey, 4,327 to the third survey, and 3,771 to the fourth in 1998.[18]

TABLE 1
Sample Sizes by Combinations of Complete Wave Observations

Wave				
1	**2**	**3**	**4**	**Observations**
x	X	x	x	942
x	X	x		371
x	X			244
x				318
x		x		133
x		x	x	180
x	X		x	190
x			x	77
	X	x	x	370
	X		x	105
	X	x		155
	X			136
		x	x	142
		x		88
			x	78
2,455	2,513	2,381	2,084	9,433

Note: Numbers correspond to usable observations (rather than survey responses). Only those with reported full-time earnings, work experience, and nonmissing values of all other covariates present in regressions are included. Observations where individuals report being in school full time are also dropped from the sample.

We restrict the analysis to those who took the GMAT, decreasing our sample size from 18,786 observations down to 15,576 and to those who reported holding current, full-time jobs (i.e., of 35 hr per week or more) with corresponding earnings, which further limited the sample to 10,946. Then, dropping those with missing control variables yields a final sample of 9,433 observations from 3,529 individuals, comprising an unbalanced panel of up to four observations per individual.[19] Of those who obtained MBAs, we include at most three pre-MBA wage observations (with at most one accompanying post-MBA observation) and at most three post-MBA wage observations (with at most one accompanying pre-MBA observation) or anything in between. For a detailed breakdown of individuals' observations within the panel, see Table 1.

16. Arcidiacono (2004) identified math aptitude as the key to undergraduate major choice and to subsequent jobs with wage premiums. Paglin and Rufolo (1990) found GRE quantitative scores to influence the choice of graduate education field of study.

17. The same survey has been used by Montgomery (2002), Montgomery and Powell (2003), and Arcidiacono et al. (2008).

18. Although attrition more heavily affected those who never entered into an MBA program than those who did, those who left the sample look similar to those who remain in a number of different observable characteristics, including gender, race, test scores, and labor market outcomes. An appendix characterizing the attrition in more detail is available on request.

19. Aiding in our identification, individuals completed MBAs over about 7 yr. We omitted wage observations for current full-time MBA students but included part-time MBA students' wages.

The GMAT Registrant Survey includes information about the following five categories: (1) demographics, (2) previous higher education (e.g., college major area of study,[20] grade point average (GPA), school quality[21] and whether possessed a postbaccalaureate degree other than an MBA), (3) a complete employment history including prior earnings and industry and work experience, (4) a set of self-assessed attributes deemed important for success in business, and (5) MBA concentration, program quality, pace (full time or part-time), and type (whether an executive program). Subsequent waves follow individuals' decisions regarding graduate management education but continue to survey individuals regardless of their decision to obtain an MBA.

Descriptive statistics of our Wave I sample are reported in Table 2, organized by whether or not the individual obtained an MBA by the end of the sample period.[22] Among those who went on to complete MBAs, sample means are also displayed separately for different areas of concentration while in business school, as reported by respondents. Our analysis focuses on the six most popular areas: general management, accounting, finance, international business, MIS and marketing. The "other" category contains the rest of the fields.[23]

Two sets of variables deserve a detailed explanation regarding their construction: (1) individual earnings and employment experience and (2) self-assessed attributes. For the former, using reported earnings and hours worked, we construct current hourly wages for up to four waves for each individual.[24] We also construct a total work experience measure based on reported starting and stopping dates of full-time jobs within the survey time span (to the nearest month), as well as responses to a question asked in the first wave regarding the number of years in total during which the respondent has worked full time for pay since age 21. While having similar years of work experience of around 5.5 yr, the MBA sample enjoys higher average Wave I wages (Table 2).

Second, in an attempt to better control for factors not captured by test scores or grades, but which may affect selection into MBA programs and of specific MBA fields of study, we include a self-assessed measure of individual ability or acquired human capital. The "self-reported attributes" variable in Table 2 aggregates the survey responses to various attribute self-assessment questions, as done in Montgomery and Powell (2003).[25] On a 4-point scale from 1 (*most*) to 4 (*least*), respondents were asked (in Wave I) to evaluate the extent to which they possess 16 attributes presumed to be useful in the business world: oral communication, written communication, ability to delegate tasks, ability to work as a team, and so on.[26] Using the negative of the sum of those answers in this study, individual's "self-reported attributes" range from −64 (*least*) to −16 (*most*). As seen in Table 2, MBAs and non-MBAs in Wave I reported virtually identical aggregate skills.

20. Rather than individual majors, we only know which of the following five broad areas students studied: business, engineering, the humanities, science, and social science.

21. In the case of undergraduate school quality, we converted the various admissions selectivity categories as designated in Barron's *Profiles of American Colleges* into the following three categories: selective undergraduate (19% of our sample), middle undergraduate (26%), and the omitted category representing the least selective schools and those not included in the Barron's guide (55%).

22. An MBA is considered a dichotomous variable throughout the analysis, only considering those who graduated from an MBA program as having the degree. Although a small number of individuals in the sample were currently enrolled in MBA programs in Wave IV, the descriptive statistics and subsequent results are robust to omitting them or accrediting partial MBAs with full or partial MBA status.

23. Small sample sizes limit our ability to accurately identify separate effects for every MBA concentration. Additional areas of concentration include, for example, human resources, health care administration, entrepreneurial management, industrial management, production/operations management, public administration, real estate, statistics or operations research, transportation, and economics. Each of the concentrations we include in "other," when included either separately or individually in the regressions summarized in Section IV, resulted in estimated coefficients that were insignificantly different from that of general management, the omitted concentration interaction.

24. Earnings (including monetary bonuses) were reported in the surveys in a number of possible ways (hourly, weekly, biweekly, monthly, or yearly). For those not reporting an hourly wage, we used individual reports of how many hours they work in a typical week to calculate a measure of hourly wage, assuming 50 weeks worked per year. We chose hourly wage, rather than annual salary or an alternative measure of earnings, in order to better conform to the returns to education literature. Furthermore, doing so allows us to abstract from issues regarding individual labor supply decisions, which may differ substantially across areas of study.

25. Montgomery and Powell (2003) refer to the variable as a "confidence index."

26. The following is a complete listing of personal attributes included in the index: initiative, high ethical standards, communication skills, ability to work with people from diverse backgrounds, shrewdness, ability to organize, physical attractiveness, assertiveness, ability to capitalize on change, ability to delegate tasks, ability to adapt theory to practical situations, understanding business in other cultures, good intuition, ability to motivate others, being a team player, and knowing the right people.

TABLE 2
Descriptive Statistics[a]

	Non-MBAs	All MBAs	General Management	Accounting	Finance	International	MIS	Marketing	Other
Wave I wage	14.90 (7.04)	15.39 (6.40)	16.23 (7.69)	13.54 (6.18)	14.72 (5.32)	13.74 (6.45)	15.63 (4.97)	14.96 (5.77)	15.31 (5.62)
Wave I work experience (yr)	5.55 (5.62)	5.59 (5.82)	6.62 (6.33)	4.49 (5.60)	4.20 (4.46)	4.20 (5.45)	7.47 (6.32)	3.80 (4.03)	6.40 (6.55)
Undergraduate GPA	2.98 (0.428)	3.08 (0.413)	3.06 (0.416)	3.15 (0.472)	3.1 (0.403)	3.11 (0.454)	3.01 (0.399)	3.11 (0.387)	3.07 (0.407)
Verbal GMAT	27.28 (7.98)	30.40 (7.55)	31.20 (7.50)	30.27 (7.29)	30.74 (6.74)	29.52 (8.50)	26.95 (7.08)	31.64 (7.51)	28.93 (7.79)
Quantitative GMAT	27.69 (8.74)	31.07 (8.09)	31.31 (8.28)	31.47 (5.84)	32.84 (7.82)	30.44 (7.42)	29.6 (7.56)	32.1 (7.58)	28.38 (8.29)
Attributes index	−28.28 (5.26)	−28.27 (5.09)	−28.64 (4.68)	−30.24 (6.21)	−28.24 (5.10)	−27.62 (5.21)	−27.45 (5.33)	−27.57 (5.36)	−28.05 (5.06)
Asian	0.153	0.137	0.091	0.236	0.212	0.210	0.200	0.150	0.086
Black	0.152	0.111	0.086	0.091	0.111	0.065	0.133	0.094	0.162
Hispanic	0.164	0.154	0.163	0.109	0.126	0.274	0.217	0.118	0.138
Female	0.440	0.384	0.369	0.527	0.247	0.339	0.433	0.441	0.490
Business undergraduate	0.504	0.482	0.430	0.727	0.523	0.484	0.517	0.444	0.476
Social science undergraduate	0.144	0.170	0.138	0.164	0.218	0.194	0.100	0.183	0.188
Humanities undergraduate	0.079	0.081	0.086	0.018	0.046	0.129	0.067	0.095	0.106
Engineering undergraduate	0.138	0.160	0.226	0.018	0.137	0.097	0.117	0.190	0.120
Sciences undergraduate	0.135	0.107	0.120	0.073	0.076	0.097	0.200	0.087	0.111
Other advanced degree	0.063	0.062	0.060	0.055	0.056	0.048	0.067	0.055	0.062
Employer pays half	—	0.550	0.560	0.455	0.535	0.419	0.733	0.535	0.562
USNews top 10	—	0.071	0.094	0.018	0.106	0.048	0.000	0.063	0.024
USNews top 11–25	—	0.090	0.051	0.036	0.172	0.048	0.033	0.173	0.067
Full time	—	0.395	0.314	0.455	0.394	0.532	0.183	0.512	0.457
Executive	—	0.081	0.160	0.000	0.061	0.081	0.083	0.031	0.024
Observations (Wave I)	1,839	1,099	350	55	198	62	60	127	247

[a]Sample restricted to those responding to Wave I survey and having nonmissing values for all relevant variables. Standard deviations are given in parentheses. "Other" MBA study concentration includes those reporting economics (9), entrepreneurial management (20), health care administration (25), human resource management (41), industrial management (5), production/operations management (33), public administration (13), real estate (7), statistics or operations research (6), transportation (2), and a self-reported other category (47).

Despite the fact that our sample is limited to individuals who took the GMAT examination, and thus possessed a certain degree of interest in obtaining an MBA, substantial observable differences exist between those who eventually obtain an MBA in the sample period and those who do not. Observable differences in ability and scholastic achievement measures exist; in particular, eventual MBAs have significantly higher verbal and quantitative GMAT scores, as well as slightly higher undergraduate GPAs. Naturally, part of these differences may just reflect the admissions standards of MBA programs.[27] MBAs and non-MBAs were equally unlikely to have obtained another advanced degree and had similar frequencies within the various undergraduate areas of study. Minorities and females, however, are somewhat less likely to obtain MBAs than Caucasians and males in the sample.

Greater differences exist between MBA fields of study than between those with and without the degree. For example, compared with those who will study general management, students in all other subject areas have lower initial wages (in the case of accounting, as much as $2.69/hr less). Those who go on to study general management, however, do typically have a relatively high amount of prior work experience (almost 3 yr more than those who will study marketing). In terms of observable skill differences, individuals who will study finance or marketing tend to have higher GMAT scores versus the lowest scores for those in the "other" category. MIS concentrators report having the highest aggregate self-reported ranking of attributes compared with the lowest for those studying accounting. Substantial demographic differences also exist across the concentration areas. Females disproportionately study accounting, MIS, marketing, and "other" and are significantly less likely to focus on finance. Asians are disproportionately located in accounting, finance, international, and MIS, but underrepresented in management. Black respondents are more likely to study MIS and "other" concentrations and Hispanics international business.

Not surprisingly, the most common area of undergraduate major, regardless of eventual MBA concentration, is business. Significant correlations exist between undergraduate major and study concentration in graduate business school. For example, a relatively large number of engineering majors study general management, whereas business majors disproportionately focus on finance or MIS. Social sciences majors tend toward finance and away from general management.

The bottom part of Table 2 considers differences in other aspects of individual's MBA education. Program heterogeneity may matter for field selection if the availability of certain fields of study varies by school quality or part-time versus full-time programs.[28] We consider this in our final specifications. We use *U.S. News & World Report* (1992) MBA quality rankings. As can be seen here, individuals attending the top 10 programs are more likely to focus on either general management or finance compared with finance or marketing for those in top 11 to 25 programs. Although 60% of MBAs in the sample attended part-time programs, the slight majority of those who studied international business or marketing attended school full time. Finally, executive MBA students are twice as likely to study general management as any other single concentration.

III. METHODOLOGY

The above discussion emphasized the differences between MBA completers and noncompleters, as well as between individuals choosing to focus on different business school subjects. As previously discussed, we have two strategies to control for selection bias. In our first method, we estimate MBA earning gains by relying on the rich set of control variables detailed above to identify observationally identical non-MBAs. In particular, we estimate equations of the form:

$$(1)\quad \ln(\text{wage}_{it}) = X_{it}\beta_1 + \text{MBA}_{it}\beta_2 + \text{MBA}_{it} \times \text{CONC}_{ij}\beta_{3j} + \varepsilon_{it}$$

where X contains covariates such as demographics, prior educational experiences, work experience, prior industry of employment, and individual ability measures (i.e., GMAT scores, undergraduate GPA, and the self-assessed soft skills); MBA_{it} indicates whether individual i obtained an MBA by time t; and CONC_{ij} is

27. While our results contradict the findings of Song et al. (2006) that college students with the greatest quantitative skills were rewarded well enough not to feel compelled to get a graduate degree, rather than a sample of all college graduates, our sample includes only those individuals interested in obtaining an MBA (enough to take the GMAT).

28. According to Segev et al. (1999), for example, all but two of the top 25 business school had finance and marketing fields, but 10 did not offer MIS and 11 did not offer international business.

an indicator variable for MBA concentration j. We focus primarily on the estimates of β_{3j} (the coefficients on the concentration interactions to be added to β_2 for their total returns) and β_2 (the coefficient on the omitted category, general management). In practice, we successively add more controls in order to investigate the effect of selection on observables on the estimates of returns to various MBA fields.

Our second strategy, fixed effects, exploits the fact that the vast majority of MBAs obtain work experience prior to enrolling in MBA programs. Rather than relying purely on characteristics and information observed by the researchers to control for selection into MBA programs and specific MBA concentrations (as in the first strategy), we rely on an individual's wage prior to business school to reveal individual fixed heterogeneity, such as ability, preferences, or career path characteristics, that are unobservable to the researcher. Thus, we also estimate fixed-effect regression equations of the form:

$$(2)\quad \ln(\text{wage}_{it}) = X_{it}\beta_1 + \text{MBA}_{it}\beta_2 + \text{MBA}_{it} \times \text{CONC}_{ij}\beta_{3j} + u_i + \varepsilon_{it}$$

where u_i, an individual fixed effect, picks up time-invariant, unobserved heterogeneity. To the extent that u_i is correlated with the decision to obtain an MBA or the choice of study concentration, OLS estimates of β_2 and β_{3j} will be biased.

The use of fixed effects also requires certain identifying assumptions for consistent estimates of each treatment effect. First, the ε_{it} should be uncorrelated with the decision of whether (or when) to obtain an MBA with each area of concentration. Alternatively, if ε_{it} are serially correlated, it may be that individuals choose to enroll in MBA programs upon receiving a negative earnings shock, when subsequent foregone earnings are expected to be lower.[29] This would result in overestimating the return to an MBA (or the particular concentration into which individuals select in this way). Another problem arises if individuals select into business school or particular concentrations on the basis of heterogeneous growth rates in earnings (or returns to experience). In this case, imposing homogeneous returns to experience in Equation (2) would again lead to a correlation between the error term and MBA enrollment. In particular, if individuals with high growth rates in wages elect to acquire an MBA concentrating in finance, for example, our estimate of the return to an MBA in finance would likely be overstated. Finally, because we use an unbalanced panel in the analysis and MBA completion occurs at different times, heterogeneous returns to an MBA (or to a particular study concentration) may result in biased estimates. In particular, this would be true if the timing of MBA completion within our sample is correlated with the return to the degree. Intuitively, if individuals completing the MBA early in our sample tend to have higher returns, they will tend to have more post-MBA earning observations entering our regression, and therefore, will be disproportionately represented in the regression. We address these possible concerns in Section V.

Beyond the base regressions above, we allow for MBA program heterogeneity in terms of quality and schedule with the inclusion of additional interaction terms. To determine whether the returns to MBA quality or program schedule can be explained in part by differences in study area concentrations across schools of different ranking, we include rank category and schedule (full time, part-time, and executive) interactions with MBA to investigate the effect of including MBA concentrations on their estimated coefficients.

IV. RESULTS

Table 3 displays our estimates of the returns to MBA study concentrations. The first column of the table reflects the simplest OLS specification, containing only race and gender indictors, the MBA field, and time variables. In successive columns, we add additional controls to the OLS model so that Column (ii) includes work experience, prior industry of employment, and whether the employer is expected to pay for at least half of the MBA program expenses, Column (iii) adds controls for accumulated human capital, and Column (v) includes MBA program differences and individual's MBA experience. Adding controls increases the amount of explained variation from 20% to 45%. Columns (iv) and (vi) represent fixed effect versions of the OLS specifications in Columns (iii) and (v).

With general management as the omitted category in each regression, the coefficient on MBA corresponds to the return to an MBA for those reporting studying general management.

29. This would be similar to the dip in earnings that has been observed prior to individuals enrolling in job training programs, which has been referred to as an Ashenfelter Dip, after Ashenfelter (1978).

TABLE 3
Main Regression Results

	i		ii		iii		iv		v		vi	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
MBA	0.1036**	0.0230	0.0625**	0.0205	0.0355*	0.0191	0.0276*	0.0142	0.0347	0.0255	0.0726**	0.0216
Finance × MBA	0.0275	0.0314	0.0960**	0.0287	0.1014**	0.0273	0.0647**	0.0219	0.0876**	0.0266	0.0579**	0.0222
Marketing × MBA	−0.0134	0.0389	0.0588	0.0366	0.0503	0.0344	−0.0110	0.0276	0.0463	0.0365	−0.0052	0.0281
Accounting × MBA	−0.1647**	0.0431	−0.1191**	0.0406	−0.0996**	0.0397	−0.0281	0.0424	−0.0697*	0.0399	−0.0151	0.0426
MIS × MBA	0.0679*	0.0398	0.0366	0.0389	0.0496	0.0377	0.0564	0.0346	0.0768**	0.0370	0.0778**	0.0346
International business × MBA	−0.0834*	0.0464	−0.0128	0.0464	0.0009	0.0441	−0.0236	0.0384	0.0171	0.0421	−0.0180	0.0385
Other concentration × MBA	0.0132	0.0327	0.0280	0.0310	0.0450	0.0296	0.0131	0.0231	0.0621**	0.0296	0.0243	0.0235
Asian	0.0573**	0.0162	0.0999**	0.0143	0.0556**	0.0142			0.0542**	0.0141		
Black	−0.051**	0.0191	−0.0582**	0.0167	0.0049	0.0163			−0.0012	0.0163		
Hispanic	−0.0296*	0.0169	−0.0281*	0.0154	0.0020	0.0146			−0.0026	0.0146		
Female	−0.1230**	0.0120	−0.0925**	0.0106	−0.0517**	0.0107			−0.0499**	0.0107		
Employer will pay half			0.0994**	0.0113	0.0951**	0.0108			0.1068**	0.0114		
Industry: agricultural, forestries, and fisheries			−0.0669**	0.0179	−0.0566**	0.0169			−0.0561**	0.0168		
Industry: manufacturing			0.0900**	0.0169	0.0453**	0.0158			0.0423**	0.0158		
Industry: service industries			0.0385**	0.0180	0.0261	0.0169			0.0210	0.0169		
Industry: finance, insurance, and real estate			0.0408**	0.0189	0.0573**	0.0179			0.0545**	0.0179		
Industry: public administration			0.0167	0.0216	−0.0037	0.0200			−0.0053	0.0200		
Other advanced degree					0.0680**	0.0184	−0.0255	0.0225	0.0691**	0.0184	−0.0281	0.0225
Quantitative GMAT (/100)					0.5985**	0.0889			0.5798**	0.0886		
Verbal GMAT (/100)					0.1091	0.0868			0.0946	0.0865		
Attributes index					0.0030**	0.0010			0.0029**	0.0010		
Social science undergraduate					0.0018	0.0152			0.0026	0.0152		

continued

TABLE 3
Continued

	i		ii		iii		iv		v		vi	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Engineering undergraduate					0.1523**	0.0148			0.1534**	0.0147		
Humanities undergraduate					−0.0005	0.0207			−0.0004	0.0206		
Sciences undergraduate					0.0884**	0.0163			0.0870**	0.0162		
Undergrad GPA					0.0659**	0.0131			0.0638**	0.0130		
Selective undergraduate					0.0738**	0.0141			0.0672**	0.0141		
Middle undergraduate					0.0395**	0.0116			0.0388**	0.0116		
Top 10 × MBA									0.2187**	0.0377	0.1179**	0.0344
Top 11–25 × MBA									0.1044**	0.0372	0.0200	0.0300
Part-time × MBA									−0.0120	0.0264	−0.0109	0.0209
Executive × MBA									0.0914**	0.0450	0.0081	0.0321
Employer paid half × MBA									−0.0541**	0.0257	−0.0835**	0.0186
Time (quartic)	Yes		Yes		Yes		Yes		Yes		Yes	
Experience (quartic)	No		Yes		Yes		Yes		Yes		Yes	
Fixed effects	No		No		No		Yes		No		Yes	
R^2	0.1983		0.3832		0.4445		0.6045		0.449		0.6079	

Note: all regressions contain 9,413 observations over 3,529 individuals.
**and *indicate coefficient is significantly different from zero at the 5 and 10% levels, respectively. Industry variables correspond to industry in which individual was employed in Wave I (if any; otherwise Wave II report was used). All correspond to pre-MBA employment.

Coefficients on each of the other concentrations should be added to this coefficient in order to determine the total return to an MBA with those concentrations. Thus, in Column (i) the greatest return of 17.2% accrues to an MBA emphasizing MIS, which is the 6.8% MIS coefficient plus the 10.4% general management coefficient. Because this specification only controls for demographics, field of study, and time, caution should be used when viewing such estimates as causal effects of particular MBA concentrations on earnings.

In Column (ii), we report estimates of a regression model, which adds employment related variables: a quartic in years of work experience, occupational industry areas reported in the Wave I survey, and whether the surveyee reported that their employer would pay half or more of the cost of the MBA program. Each of those variables was significant, except for prior employment in public administration. Furthermore, the estimates of the concentration premiums change substantially from Column (i), suggesting that individuals select into particular concentrations in part on the basis of prior employment experience characteristics.[30] Their inclusion can be viewed as an initial step toward more complete control for selection into different MBA concentrations by picking up differences in initial employment characteristics. The amount of explained variation (adjusted R^2) almost doubles from .2 to .38.

Column (iii) reports estimates of a regression model including a more comprehensive set of controls intended to pick up differences in accumulated human capital. This specification adds to the Column (ii) specification GMAT scores, undergraduate areas of study, the quality of the baccalaureate institution, whether they have a separate graduate degree, and a self-assessment of attributes. Including these variables increased the amount of explained variation in earnings from .38 to .44. This specification reduces the estimated return to general management (the MBA coefficient) by 40%, but otherwise did not significantly alter the relative returns to MBA areas of concentration. The total return to an MBA of most concentrations decreases slightly, however, reflecting positive selection on ability into MBA programs; that is, most MBAs appear to be stronger in measures of observed ability than those who do not obtain the degree. With the exception of verbal GMAT scores, all our individual ability or achievement controls (i.e., undergraduate GPA, quantitative GMAT scores, and the self-reported attributes index) were found to be positive and significant, as were selectivity measures of undergraduate college quality. Business undergraduate majors (the omitted category) enjoy lower earnings than two of the four other undergraduate categories. Engineering majors enjoyed the highest average earnings, a full 15.2% above that of a comparable business major.

Column (iv) of Table 3 reports controlling for selection into an MBA and area of concentration a step further by including individual fixed effects, allowing us to control for time-invariant, unobserved heterogeneity as reflected in an individual's wage. Including fixed effect results in a drop in the estimates of the returns to most concentrations, suggesting a general positive ability bias associated with incomplete controls in the OLS specifications.

In the final OLS specification, we introduce several degrees of MBA program heterogeneity and individual's MBA experience (Column [v]). Returns to the MBA degree have been found to be heavily influenced by program quality, pace of program, and employer sponsorship or reimbursement of individual costs (Arcidiacono et al. 2008). We attempt to determine how much of the observed differences in MBA returns along these dimensions can be explained by differential returns across MBA concentrations or, conversely, will estimates of the return to different MBA fields become more similar (or more differentiated) when we control for certain types of MBA program heterogeneity?

Our results may change when program heterogeneity is included because, for example, students attending top-ranked schools are more heavily concentrated in certain high-return study areas such as finance (Table 2). Allowing for these forms of heterogeneity importantly affects our results of the returns to MBA concentration: the finance premium increases to 9% and the MIS concentration becomes strongly significant with an 8% wage premium. These are both in addition to the general MBA estimate of 3.5, which should now be interpreted (because of the many interaction terms in the regression) as the return to an MBA for a student paying their own way to study general management in a full-time

30. Although nearly all of the labor market variables are significant, the most important by far in affecting the returns to an MBA and specific concentrations is work experience. In fact, including work experience and not the other employment variables results in estimates that are not statistically different from those reported in Column (ii).

program outside the top 25. Thus, apparently both general MBA quality and choice of study concentration are independently important determinants of the returns to an MBA.[31]

Finally, Column (vi) of Table 3 includes the same program quality and type indicators as in the OLS specification (Column [v]) and also includes individual fixed effects. The return to a general management MBA regains its significance, relative to the comparable OLS estimate, to over 7%. The total returns to finance increased slightly to 13% and MIS to 15%. Relative to the OLS estimates, the fixed effects return to MBA program rank diminished severely, such that a premium for schools in the top 11–25 no longer exists, and the return to top 10 schools is cut in half, although still a significant 12% above schools outside the top 25. These results are not surprising, given that individuals who attend top-ranked programs are likely to be those with the most unobserved ability. The estimated returns to an MIS or finance MBA at a school outside the top 25, at about 15 and 13%, respectively, are significantly larger than the estimated return to studying general management at a top 25 school and approaches the returns to studying general management at a top 10 school. Thus, like the undergraduate literature, we find independent returns to MBA program quality and to field of study, such that MBA students at nonprestigious programs could compensate for the lack of program quality by selecting well-rewarded areas of concentration.

The higher returns to finance and MIS concentrators are revealed in Table 3 in very different ways. The premium for finance exists in all specifications, but in each set of paired OLS and FE models, the FE coefficients are about 40% lower than in the OLS results—a pattern that reflects positive selection on unobservables. By contrast, the MIS premium (a) only expresses itself when program quality and type are included (i.e., in the last two specifications) and (b) has similar coefficients whether estimated via OLS or FE.

When taken as a whole, the results in Table 3 tell an interesting story of selection both into business school programs of varying quality and into specific MBA fields of study. In general, the addition of more control variables, in OLS specifications, reduces the significance and magnitude of the estimates of the returns to most MBA concentrations, suggesting positive selection on observables. The first fixed-effect specification, without MBA program characteristics (iv), yields similar results to the comparable OLS specification (Column [iii])—high returns to most fields but low and less significant gains for general management concentrators.

The addition of MBA program characteristics causes divergent OLS versus fixed-effect estimates of returns to concentration and to program quality. Interestingly, we found evidence of positive selection on unobservables into high-quality programs but negative sorting into general management at lower ranked programs. In the full fixed-effect specification (Column [vi]) relative to the full OLS one (v), the return to attending a top 10 business school falls by half (to 12%) and premiums disappears altogether for those in top 11–25 schools. Thus, the fixed-effect and OLS results indicate that students *positively* sorted into top business schools on the basis of characteristics unobservable to the researcher. As might be expected, individuals with the greatest degree of unobserved ability tend to be located at the most elite programs, as MBA admissions officers have access to much more detailed information about early career accomplishments, letters of reference, and other application materials not included in the GMAT Registrant Survey. Regarding the return to field of study, however, the final fixed-effect versus OLS results indicate that general management concentrators earn significantly higher earnings (7% more). The increase in this estimate provides evidence of *negative* selection for a certain segment of the sample—those who study general management at full-time programs outside the top 25 may be *less* able in unobserved ways as compared to those who obtain no MBA.[32]

31. That is, alternatively, the inclusion of study concentrations did not substantially affect the estimated return to attending top-ranked schools. In addition, it is worth noting that undergraduate quality also remains significant, despite the inclusion of college major, broad initial industry variables, and postgraduate degrees. Because of small sample sizes of MBAs at top-ranked institutions, we were unable to investigate differential returns to concentration by program quality.

32. Arcidiacono et al. (2008) find a similar result for those attending full-time, lower ranked programs. To the extent that estimates of the returns to the more specific concentrations do not differ substantially between OLS and fixed effects, our analysis suggests that evidence of negative selection is isolated in a smaller group—attending lower ranked programs to study general management, without a specific concentration, may serve to compensate for lower workplace skills.

V. ROBUSTNESS CHECKS

In this section, we consider each assumption required for consistent estimates, particularly in the fixed-effect framework, and carry out additional robustness checks addressing other possible concerns. To begin, it should be noted that OLS and fixed-effect estimates might not be directly comparable, because estimates from the two methodologies are identified off of different samples. In particular, the fixed-effect specifications use solely within-individual variation to estimate the average treatment effect on the treated for each type of MBA program and study concentration, thus using only the MBA sample for identification. OLS identifies the MBA coefficients off of both the timing of MBA completion and the differences between the MBA and the non-MBA samples. For the purposes of comparison, we reran each specification in Table 3 using only those individuals who obtained MBAs within the sample period. Although the magnitude of the coefficient representing the general management MBA was altered in a couple of cases, the relationships between the OLS and fixed-effect estimates, within and across each of the study concentrations, were substantively unchanged.[33]

As discussed in Section III, one way in which our estimates of the returns to an MBA and concentration premiums could be biased is if individuals select into an MBA or particular fields of study on the basis of prior wage shocks. If negative wage shocks (either specific to an individual's employment situation or more generally within an industry) tend to precede enrollment into a particular type of MBA program, these negative residuals will lead to inflated estimates of the return to that type of MBA. Although this would affect both OLS and fixed-effect estimates, the fixed-effect estimates would be affected to a greater degree due to the explicit within-individual comparison of pre- and post-MBA wages. Because individuals in our sample obtained MBAs at different points in time, one way to check for the possibility of pre-enrollment wage shocks is to investigate the behavior of the residuals prior to MBA enrollment. Table 4 does just this, by displaying the mean residuals from our final fixed-effect specification by MBA study concentration and by years leading up to MBA enrollment. As seen in the table, the wage residuals are neither consistently negative nor consistently positive prior to enrollment for any concentration. Even in the few cases where the mean residuals marginally statistically differ from zero, no consistent sign or trend exists in the few years leading up to the time of enrollment. We also ran a regression including indicator variables for 1 and 2 yr before enrolling (for the individuals who obtained an MBA). The coefficients on these variables were not significant and did not substantially change any of the other coefficients. Despite our relatively small sample sizes, the same was true when we allowed the coefficients on these pre-enrollment variables to vary by MBA concentration. None of the variables were individually significant, and an F test rejected their joint significance. Furthermore, their inclusion did not meaningfully alter any of the coefficients of interest.

A second, but related, possibility is that individuals who obtain an MBA in certain fields may more generally have steeper or shallower experience-earning profiles (either due to their individual characteristics or the nature of the industries or firms in which they are employed). To investigate this possibility, we again looked at wage residuals prior to enrollment. If individuals selecting particular fields have higher returns to experience, their residuals should generally increase as proximity to enrollment decreases. However, for no type of study concentration does there appear to be a trend in residuals, either positive or negative. As a more direct test of heterogeneity in returns to experience, we interacted work experience with each concentration (for those who ultimately obtained an MBA). According to an F test, we could not reject the hypothesis that the returns to experience were the same across concentrations and for those who did not obtain an MBA ($F = 1.21$).

Finally, to the degree that the returns to a particular type of MBA may be correlated with the timing of MBA completion within our sample, the estimates of the return may be influenced by the number of post-MBA earning observations. However, we found no significant correlation between any of the concentration areas and the timing of enrollment. Furthermore, we reran the analysis using two separate subsamples: only individuals with at least three valid

33. More specifically, the coefficient on MBA (general management) increased in the fuller specifications. This further supports the idea of negative selection—that individuals studying general management at lower ranked programs may be less able than individuals who do not obtain an MBA. We thank the referee for suggesting this comparison. Results are available upon request.

TABLE 4
Residuals Prior to MBA Enrollment By Concentration

		Years Prior to Enrollment		
		Between 2 and 3	**Between 1 and 2**	**Less than 1**
Finance	Mean	−0.0095	0.0147	−0.0065
	Standard deviation	0.0886	0.1339	0.1430
	Observations	42	80	186
Marketing	Mean	0.0140	0.0087	0.0112
	Standard deviation	0.1361	0.1652	0.1806
	Observations	21	45	98
Accounting	Mean	−0.0955[a]	0.1225[a]	−0.0159
	Standard deviation	0.1238	0.2625	0.1295
	Observations	9	18	50
MIS	Mean	−0.0056	0.0141	−0.0014
	Standard deviation	0.0907	0.1423	0.1113
	Observations	19	29	54
General management	Mean	−0.0221	0.0033	0.0060
	Standard deviation	0.1608	0.1730	0.1504
	Observations	62	132	298
International business	Mean	−0.0103	0.0514	−0.0375[a]
	Standard deviation	0.2481	0.2076	0.1305
	Observations	11	18	47
Other	Mean	0.0002	−0.0183	0.0002
	Standard deviation	0.1660	0.1272	0.1488
	Observations	53	87	197

Notes: Reported statistics correspond to residuals from fixed-effect regression of log wage on variables represented in Column (vi) of Table 3.
[a]A rejection at the 10% level of the null hypothesis that the mean is equal to zero.

earning observations and only individuals with all four valid observations. Although the smaller sample sizes increased standard errors somewhat, none of our findings were altered in any substantive way.

Our results are also robust to a variety of other specification checks. We find little change when we replicate the results reported in Table 3 without the self-assessed attributes, employer pays tuition, or its interaction with MBA. Gender seems not to matter much. The analysis was run separately by gender, as well as by including female interaction terms with the concentration variables. We found no evidence of statistical differences across men and women in the returns to any concentration, except that women with MIS concentrations earned much more (18%). African Americans with fields in finance and marketing also experienced very high earning premiums. Finally, we used the log of annual salary, rather than log of hourly wage, as the dependent variable. Although general relationships between the estimates of the various concentrations were unchanged, the returns to several of the specific concentrations increased. Although the returns to studying general management and accounting remained the same, the estimates of the earning premiums for finance and MIS increased to 9.3% and 10.6%, respectively (in the final fixed-effect specification).

VI. PREDICTORS OF AREA OF CONCENTRATION CHOICE

Many studies document substantial differences in postcollegiate earnings across majors (Arcidiacono 2004; Daymont and Andrisani 1984; Finnie and Frenette 2003; Fiorito and Daufferbach 1982; Grogger and Eide 1995; James et al. 1989; Loury 1997; Loury and Garman 1995). The sizable literature on undergraduate major choice by economists has emphasized expected lifetime earnings/utility (Berger 1988; Monmarquette et al. 2002; Rumberger and Thomas 1993), relative abilities (Arcidiacono 2004), uncertainty (Altonji 1993), patterns of labor force participation (Blakeman and Low 1984; Polachek 1978), individual nonprice preference (Easterlin 1995; Fiorito and Daufferbach

1982), and the probability of graduation (Montmarquette et al. 2002). From the econometrician's point of view, although undergraduates' major choice is estimated based on high school and college experiences, MBA students have a much richer set of potential indicators of fields of interest beyond demographic variables and standardized test scores, already having undergraduate degrees, college majors, and varying work experience.

In the previous section, we presented results of estimations of wage premiums by MBA field of study. By gradually increasing the number and type of controls included in the regressions, we were able to analyze the type of selection going on into both MBA programs and choice of concentration. We now focus more particularly on the patterns and predictors of concentration choice using multinomial logit and logit techniques on the sample of MBA completers.

Our multinomial logit estimates compare the predictors of selecting one of the six fields (i.e., accounting, finance, international business, MIS, marketing, and everything else in the "other" category) relative to the excluded field of general management, using the same control variables we used in our earning regressions. A variety of factors predict sorting into different areas of study (Table 5). For example, aside from finance, the following variables predict the following fields, all relative to general management: marketing—more likely if from a top undergraduate school, a top 11–25 MBA program, or an employer pays half the tuition and less likely for part-time students, those in executive education programs or with more experience; accounting—negatively associated with self-reported soft attributes; MIS—more likely if Asian and employer pays tuition; International—more likely if Asian or Hispanic or have less employment experience.

Gender wage gaps among the college educated have been attributed to differences in college major choice either in part (Blakeman and Low 1984; Brown and Corcoran 1997; Daymont and Andrisani 1984; Loury 1997; Paglin and Rufolo 1990; Polachek 1978; Turner and Bowen 1999) or predominantly (McDonald and Thornton 2007). If overall women had 5% lower wages (Table 3), controlling for concentration, does differential sorting into concentrations serve to increase or decrease the gender wage gap in the case of MBAs? Our estimates indicate significant gender differences in choice of field of study with a reduced likelihood of women planning to or actually concentrating in finance and an increase in the likelihood of concentrating in accounting, either relative to general management among six concentrations (the multinomial logit model) or relative to all other fields (the logit model).[34] To the extent that finance has been shown to have a substantial earning premium and accounting a relatively low premium, this suggests that part of the raw gender wage gap may be explained by sorting into concentrations. To investigate this possibility further, using the sample who obtained MBAs, we compared the gender differential before and after the inclusion of concentration areas. For the full OLS specifications, the female coefficient decreased from −.0600 to −.0508, suggesting a modest but meaningful decrease in the gender gap when we control for area of study.

We will focus now on finance concentrators because they received substantial wage premiums and constitute a larger share of MBAs (18%) than do MIS concentrators (5.4%), the other field with such outsized earning premiums. The following variables predict both expected and actual finance concentrations: positively for working in the finance industry and for blacks and Asians and negatively for undergraduate humanities majors, females, and for those with more work experience (all are relative to management, the omitted category).[35] Beyond those factors, additional predictors of actual finance concentrators are high quantitative and low verbal GMAT scores and graduating from a top 11–25 MBA program. In general, relative to general management, the finance concentration is predicted by a larger set of variables than is any other field. In addition to the foregoing multinomial logit estimates, we use logit regressions to estimate what factors influence the binary choice of finance versus some other field (Table 6). The same basic set of variables predicts finance concentration relative to all other choice, either estimated with logit or multinominal logit.

Relative to general management (in a multinomial logit regression), quantitative scores

34. Montgomery and Anderson (2007) report that about 30% more female than male registrants who took the GMAT in this data set failed to complete the MBA degree.

35. In this study, the only industry category to predict an area of concentration was finance, insurance, and real estate's association with the finance concentration, which is not a surprise because only that combination offers a clear industry-field link.

TABLE 5
Multinomial Logit Estimates of MBA Concentration

	Finance	Marketing	Accounting	MIS	International Business	Other
Industry: agriculture	−33.953 (3.95e+07)	−34.344 (3.81e+07)	−1.626 (8.85e+07)	−34.202 (7.32e+07)	−35.270 (7.05e+07)	−34.478 (3.00e+07)
Industry: manufacturing	−0.113 (0.360)	0.305 (0.387)	−0.267 (0.624)	−1.372** (0.595)	0.431 (0.582)	−0.072 (0.324)
Industry: service	−0.111 (0.371)	−0.018 (0.416)	−0.137 (0.569)	0.176 (0.494)	0.041 (0.594)	0.146 (0.333)
Industry: finance, insurance, real estate	0.975** (0.363)	−0.419 (0.488)	−0.433 (0.684)	−0.230 (0.568)	0.105 (0.648)	0.205 (0.377)
Industry: public administration	−0.344 (0.454)	−1.112* (0.632)	−0.775 (0.860)	0.251 (0.531)	0.366 (0.658)	0.441 (0.358)
Quantitative GMAT	0.045** (0.021)	−0.002 (0.024)	0.018 (0.038)	0.055* (0.031)	−0.007 (0.032)	−0.017 (0.018)
Verbal GMAT	−0.042** (0.021)	0.005 (0.024)	0.014 (0.035)	−0.055* (0.030)	0.003 (0.032)	−0.008 (0.018)
Undergraduate GPA	0.221 (0.291)	0.201 (0.341)	−0.105 (0.529)	−0.463 (0.429)	−0.040 (0.465)	0.033 (0.255)
Attributes index	−0.001 (0.021)	0.045* (0.027)	−0.097** (0.042)	0.066** (0.033)	0.040 (0.035)	0.012 (0.020)
Social sciences undergraduate	0.131 (0.309)	0.308 (0.381)	−0.226 (0.553)	−0.298 (0.557)	0.107 (0.540)	0.295 (0.295)
Engineering undergraduate	−1.114** (0.361)	−0.286 (0.405)	−33.588 (4870381)	−0.958** (0.579)	−0.712 (0.605)	0.107 (0.318)
Humanities undergraduate	−0.364 (0.513)	0.706 (0.471)	−33.154 (8698211)	0.196 (0.709)	0.581 (0.653)	0.470 (0.390)
Sciences undergraduate	−0.671 (0.415)	−0.112 (0.467)	−0.546 (0.658)	0.384 (0.487)	0.378 (0.554)	0.343 (0.328)
Middle undergraduate	0.248 (0.272)	0.521 (0.326)	0.595 (0.465)	0.307 (0.403)	−0.101 (0.425)	0.011 (0.249)
Selective undergraduate	0.339 (0.322)	0.838** (0.370)	−0.942 (0.860)	−0.313 (0.581)	−1.018* (0.605)	−0.204 (0.308)
Top 10 × MBA	0.091 (0.421)	−0.818 (0.532)	−1.133 (1.184)	−32.398 (7328266)	−0.880 (0.866)	−0.430 (0.445)
Top 11–25 × MBA	1.369** (0.403)	1.147** (0.438)	−32.353 (7376844)	−0.179 (0.842)	−0.247 (0.832)	0.635 (0.427)
Part-time × MBA	0.324 (0.311)	−0.691** (0.340)	−0.463 (0.489)	0.475 (0.488)	−0.510 (0.459)	−0.631** (0.257)
Executive × MBA	−0.744 (0.466)	−2.166** (0.674)	−33.737 (7871399)	−0.728 (0.726)	−0.909 (0.676)	−2.438** (0.523)
Employer paid half	0.326 (0.284)	0.830** (0.341)	0.057 (0.492)	1.076** (0.428)	0.085 (0.432)	0.587** (0.246)
Asian	0.981** (0.337)	0.171 (0.408)	1.330** (0.601)	1.104** (0.515)	1.665** (0.521)	0.199 (0.357)
Black	1.013** (0.395)	−0.023 (0.496)	−0.905 (1.119)	0.754 (0.595)	−0.191 (0.833)	0.388 (0.339)
Hispanic	0.125 (0.330)	−0.665 (0.453)	0.097 (0.620)	0.536 (0.459)	1.173** (0.443)	−0.059 (0.296)
Female	−0.884** (0.260)	0.197 (0.281)	0.872* (0.455)	0.022 (0.378)	−0.155 (0.387)	0.225 (0.222)
Experience	−0.066** (0.023)	−0.084** (0.029)	−0.001 (0.036)	0.003 (0.027)	−0.084** (0.039)	−0.003 (0.017)

Notes: Reported values represent coefficient estimates from a multinomial logit regression over actual field of study among MBA graduates. Standard errors are in parentheses. The omitted category is general management. Eight hundred forty-three observations were included.

**and *indicate coefficient is statistically significantly different from zero at the 5% and 10% levels, respectively.

TABLE 6
Logit Estimates of Planned and Actual Concentration in Finance

	PLAN FINANCE	FINANCE
Industry: manufacturing	0.174 (0.335)	−0.059 (0.325)
Industry: service	0.018 (0.347)	−0.119 (0.332)
Industry: finance, insurance, real estate	1.042** (0.326)	1.028** (0.311)
Industry: public administration	−0.685 (0.485)	−0.360 (0.412)
Quantitative GMAT	0.056** (0.019)	0.046** (0.018)
Verbal GMAT	−0.043** (0.019)	−0.037** (0.018)
Undergraduate GPA	−0.104 (0.276)	0.234 (0.262)
Attributes index	−0.008 (0.020)	−0.015 (0.019)
Social sciences undergraduate	−0.745** (0.308)	0.029 (0.271)
Engineering undergraduate	−1.450** (0.357)	−0.911** (0.327)
Humanities undergraduate	−1.761** (0.644)	−0.640 (0.465)
Sciences undergraduate	−0.897** (0.379)	−0.780** (0.379)
Middle undergraduate	0.175 (0.252)	0.149 (0.243)
Selective undergraduate	0.510* (0.291)	0.349 (0.289)
Top 10 × MBA		0.468 (0.382)
Top 11–25 × MBA		0.982** (0.307)
Part-time × MBA		0.617** (0.276)
Executive × MBA		0.164 (0.438)
Employer paid half		−0.016 (0.253)
Asian	0.696** (0.295)	0.629** (0.281)
Black	0.881** (0.354)	0.882** (0.349)
Hispanic	−0.081 (0.324)	0.094 (0.299)
Female	−0.942** (0.246)	−1.023** (0.234)
Experience	−0.043** (0.022)	−0.054** (0.021)
N	843	843
Pseudo R^2	0.1393	0.1472

Notes: Reported values represent coefficient estimates from logit regressions over planned (as of Wave I) and actual concentration in finance among MBA graduates. Standard errors are in parentheses. The omitted category is planned or actual concentration in a nonfinance field or General Management.

**and *indicate coefficient is statistically significantly different from zero at the 5% and 10% levels, respectively.

only significantly increase the likelihood of concentrating in finance rather than into each of the six other fields (Table 5).[36] In a logit model, quantitative GMAT scores significantly predict both students' expected (at the time of Wave I) and actual concentration in finance compared with choosing some other area of study (Table 6). Average quantitative scores of planned and actual finance concentrators exceeded those of nonfinance students. We also compared the quantitative GMAT scores of individuals who kept their original study concentration plans to those who reported concentrating in an area different from their expectation in Wave I. Among individuals who had initially planned on a nonfinance field, those who switched to finance had much higher quantitative scores than did the students who changed to any other nonfinance field (33.32 vs. 30.44, respectively). However, among expected finance concentrators, those who strayed to a nonfinance field had higher quantitative scores than did those who stayed with their finance plans (33.32 and 32.3, respectively), a pattern in keeping with the fact that MBA concentration switchers had higher quantitative scores than did stayers (30.3 and 28.2, respectively). Overall, then, we find a strong association between quantitative skills and the finance field.

Thus, quantitative GMAT scores appear to function as a sorting mechanism into finance among the range of concentration options. According to Paglin and Rufolo (1990), quantitative skills influenced the choice of graduate fields of study, such as economics, physics, and so on (rather than, as we investigate, the subfields within a discipline). Murane, Willett, and Levy (1995) attribute much of the rising return to a college education from late 1970s to the late 1980s to the increasing returns to quantitative skills. Quantitative skills have been linked by others to more educational attainment (Taber 2001; Willis and Rosen 1979), specific college majors (Arcidiacono 2004; Fiorito and Dauffenbach 1982), the choice of graduate education field of study (Paglin and Rufolo 1999), graduate school attendance (Song et al. 2007), and higher earnings (Arcidiacono 2004; Grogger and Eide 1995).

VII. CONCLUSIONS

This article offers the first estimates of the returns to fields of study versus to school quality for a nonbaccalaureate institution, although a voluminous literature has addressed this question for college graduates. Our analysis is of students obtaining the MBA, the third most

36. High quantitative and low verbal scores also marginally predict choosing an MIS concentration (at the 10% level).

common higher education degree. The analysis is unique in several ways. We offer the first estimates of the returns to MBAs' areas of concentration and then compare those to the returns to MBA program quality. Also, to our knowledge, it is the first to estimate returns to fields of study for students with prior work experience and earnings. Ex ante wages both allow us to estimate individual earning gains from an MBA and convey otherwise unobservable information about an individual's ability and ambition. Finally, in this article, we provide the first analysis of MBAs' choice of an area of concentration and find that quantitative skills function as a field-of-study sorting mechanism.

Several interesting findings emerged. We find substantial wage premiums for MIS and finance of roughly double the 7% return to most of the other areas of concentration. We do not know whether MIS and finance still yield higher than average earnings or whether our results represent particular historical events due to technological and financial innovations. Might the MIS premiums be tied to advances in IT, which diffused through corporate America as evidenced by the dot.com boom of the 1990s? Our evidence of substantial finance premiums certainly conforms to the long-run pattern of increased compensation for the finance sector documented by two recent academic studies that have been widely cited by the popular press in an attempt to understand the current financial crisis.[37] A modest finance wage premium of 10% more than comparable workers in 1980 grew, according to Philippon and Reshef (2007) to 50% by 2005. Goldin and Katz (2008) found that Harvard graduates in finance jobs in 2005 earned an astounding three times more than their fellow alums employed in other careers, controlling for a wide array of characteristics.

The second contribution of this study compares the payoff to program quality versus areas of concentration; we find that concentrating in finance or MIS at a nontop 25 program yields a greater return than does studying general management at a school in the top 11–25, and two-thirds and 80%, respectively, of studying general management at top 10 schools. Thus, although the majority of the MBAs likely made geographically constrained program choice due to existing job and family ties, overcoming this constraint was largely possible via specializing in finance or MIS. This finding correlates to that of the undergraduate literature, which finds a premium for typical graduates of elite schools but an even larger one for engineers, science, and others majors from nonelite universities and colleges (Fitzgerald 2000; James et al. 1989). Interestingly, although we found evidence of positive selection on unobservables into high-quality programs, comparing our OLS versus fixed-effect estimates suggests that students negatively select into studying general management at lower ranked programs.

Monetary returns are only one reason people obtain an MBA. These returns may correlate (inversely) with nonmonetary benefits of studying certain fields or getting certain types of jobs. To the extent possible, however, we investigated, but found no statistically significant results regarding differences by MBA concentrations in nonpecuniary benefits, such as self-reported skills gains and satisfaction with each of the following: present job, present pay, opportunities for promotion, and job in general.[38]

Limitations of our analysis include the relatively short-run effects that our data allow us to estimate. Differences in lifetime returns across fields of study may differ substantially over a longer time frame. In addition, our analysis does not distinguish whether areas of concentration reflect actual human capital accumulation or function as signaling devices. Unfortunately, areas of concentration are self-reported, and we lack precise information regarding the actual content and the type and extent of learning that goes on in each. Finally, we find that, like undergraduates, most MBAs switch from their expected fields of concentration. Given the importance of MBAs' field of study, further research may suggest the roles that faculty, courses, internships, and peers play in students' concentration choice.

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37. See, for example, David Wessel's article entitled "A Burst Bubble May Be a Boon" (*WSJ*, Jan. 17, 2008, p. A2) and Justin Lahart's "Has the Financial Industry's Heyday Com and Gone?" (*WSJ*, April 28, 2008). Also, for example, the *NYT* on-line search engine indicated 11 citations of Philippon and Reshef (2007).

38. The GMAT Registrant Survey Wave IV contains three of the five Job Descriptive Index surveys (excluded are the Supervision and the Coworkers surveys) and the related Job in General survey (Smith et al. 1987 and the JDI homepage: http://showcase.bgsu.edu/IOPsych/jdi/index.html).

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