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ABSTRACT

This paper explores the relationship between fees charged by MBA programmes and the number of applications to these programmes, using a panel dataset comprising universities from countries across the world. Using Three-Stage-Least-Squares methods for simultaneous equations, we find a two-way relationship between fees and applications: higher application numbers encourage universities to charge higher fees in the future, but higher fees in turn curtail application numbers. Of particular note are the results pertaining to additional explanatory variables that potentially represent MBA programme quality signals to applicants. We find evidence that higher GMAT scores of existing students increase applications, as do higher post MBA salaries. Meanwhile, university and programme professional accreditations do not impact on student application choices, nor do alumni ratings of programme quality. Published MBA programme rankings appear to have little impact on applications, and where an effect can be identified, it appears that a better ranking discourages applications.

JEL Classification: I21, D12.

Keywords: MBAs; fees; applications; simultaneous equations.

1. INTRODUCTION

The MBA is a relatively new qualification: the first MBA programme was introduced by the Harvard Graduate School of Business Administration in 1908, while the first European MBA was introduced by INSEAD in 1957. The MBA education sector has expanded rapidly in the past 40 years, as companies have sought to improve the training of their managers. On the employee side, an MBA has been seen as a way to open new career opportunities and as a means of personal development, primarily for students with pre-existing work experience (Ridgers, 2009). These are typically premium-fee programmes, with direct high costs of attending an MBA programme coupled with the opportunity cost of giving up full-time employment for the duration of the programme in the case of full-time MBAs.[1]

Fees vary considerably, both within as well as across countries. As a result, it is perhaps natural to question whether the MBA sector operates according to the market forces of demand and supply. At the most basic level, the question would be: 'Do higher fees reduce demand, and does higher demand imply higher fees in the future?' A more sophisticated version of this question would be: 'What are the factors that influence the demand for places on MBA programmes – the quality of the institution, post-MBA salaries, alumni networks, or something else?' This question is particularly important to ask, as, while there is already a large literature considering demand for undergraduate degree programmes, the literature considering demand for postgraduate qualifications, including MBAs, is very limited.

[1] Apart from full-time MBAs, there are Executive MBAs (EMBAs) which primarily involve evening and weekend classes and are generally taken by people who remain in full-time employment during the programme. This reduces the opportunity cost in financial terms for those on EMBAs; however, there remains the opportunity cost of time which could have been spent on leisure or with friends and family.

These questions are addressed in this paper. That is, we investigate the relationship between MBA fees and application numbers, as well as the impact of other factors that are believed to have a possible bearing on the decision regarding to which programmes to apply. The analysis uses a panel dataset of universities across the world, and simultaneous equations methods to identify a two-way relationship between fees and application numbers. Our main finding is that the MBA market does indeed operate according to the market forces of demand and supply: higher fees reduce the number of applications, whilst more applications in the previous year encourage universities to raise fees. Results are robust to the inclusion of additional variables in the model, as well as in a sub-sample of US-only institutions. Of particular note are the results pertaining to additional explanatory variables that potentially represent MBA programme quality signals to applicants. We find evidence that higher GMAT scores of existing students increase applications, as do higher post MBA salaries. Meanwhile, university and programme professional accreditations do not impact on student application choices, nor do alumni ratings of programme quality. Published MBA programme rankings appear to have little impact on applications, and where an effect can be identified, it appears that a better ranking discourages applications. We hypothesize that this reflects weaker students being discouraged from applying to programmes that achieve better rankings.

The next section provides a brief review of the related literature, showing how the present paper contributes to existing knowledge. Section 3 discusses the data, while Section 4 presents the econometric methods and Section 5 the results. Section 6 provides some concluding comments.

2. LITERATURE REVIEW

This paper offers original contributions to two existing literatures, namely the literature on factors influencing higher education choices, and the literature on the determinants of university tuition fees. However, the analysis focuses on the MBA market which appears to have been somewhat neglected in the economics of education literature until recently. We speculate that this reflects a sparseness of suitable data, with the only data used to date being that collated by the Graduate Management Admissions Council (GMAC). This market is particularly valuable to understand, given the high costs associated with MBA study. The market for an MBA education is also interesting to analyze as it is international, with students often moving from their home country in order to undertake MBA studies. The limited existing literature on demand for an MBA qualification includes Montgomery (2002) who uses a nested logit model to examine the factors influencing US individuals' choice of MBA school. Meanwhile Montgomery and Powell (2003) examine the post-MBA gender wage gap, and Arcidiacono et al. (2008), Grove and Hussey (2011a) estimate the financial returns of an MBA. Grove and Hussey (2011b) go onto consider the school and individual factors impacting on returns to an MBA, while Hussey (2011a) focuses specifically on the impact of MBA graduates' ethics and MBA ethics training on returns to an MBA. Rather than focus on the financial returns to an MBA, Hussey (2011b) examines the impact of an MBA qualification on managerial position.

Unlike these papers which all use individual alumnus survey data from GMAC, the current study instead focuses on institution level data from the Which MBA guide. Whilst the use of institution level data means that we lose some of the richness of the individual level data from GMAC, our dataset provides other information on variables such as university and programme accreditations,

and published programme rankings. Such variables enable us to address the questions posed in the introduction, providing an insight into the impact of quality indicators on demand for an MBA which can be considered to be an experience good.

More generally, on the factors influencing students' higher education decision choices, a number of issues have been addressed in the existing literature including the factors influencing the decision to attend university after school (Psacharopoulos and Soumelis (1979), Menon (1998)), and the decision to study overseas (Altbach (1991), Mazzarol (1998), Mazzarol and Soutar (2002), Nattavud (2005)). A number of recent papers consider the impact of published college rankings on US college applications, namely Griffith and Rask (2007), Bowman and Bastedo (2009) and Luca and Smith (2011), with Gunn and Hill (2008) considering the impact of university league tables on applications for undergraduate places in the UK. Meanwhile, Bezmen and Depken II (1998) focus on the impact of objectively measurable college characteristics on US undergraduate application rates.

A number of papers already examine the impact of tuition fees on demand for a university education, with Blaug (1981) and Woodhall (1991) offering early analyses of the impact of fees in the UK on overseas student demand for higher education, and Leslie and Brinkman (1987), Savoca (1990), Heller (1997), and Cameron and Heckman (1999) offering US analyses, while Neill (2009) considers the Canadian market. Neill's (2009) contribution is particularly valuable due to the instrumental variable approach adopted to take account of the endogeneity of fees, although Epple et al.'s (2006) simultaneous equation model of demand, financial aid, educational expenditure and outcomes must also be noted. However, while a number of studies have

examined the multiple factors influencing students' university choices, including Elliott and Soo (2010) and Abbott and Leslie (2004), much of the existing literature focuses on undergraduate university choice. This paper expands the literature by instead examining the institution level factors influencing decisions to study for an MBA qualification.

A separate strand of literature considers the factors that determine levels of university tuition fees. Numerous hedonic pricing models have been reported in academic literature across economics and management disciplines since Rosen's (1974) and Lucas's (1975) influential depiction of hedonic pricing methods. Traditionally, only objective factors that are expected to have a direct impact on prices were included as explanatory variables, although nowadays the term hedonic pricing model is sometimes used more loosely to denote models of objective as well as subjective factors influencing prices. Applications of the hedonic pricing model to the pricing of education continue to grow. An early example is Harford and Marcus's (1986) analysis of undergraduate private college fees in the US. The literature has since been developed by Koshal et al. (1994); Koshal and Koshal (1998); Dimkpah et al. (2004); Schwartz and Scafidi (2004) and McMillen et al. (2007). However, with the exception of Schwartz and Scafidi (2004), who have a panel of five years duration, the literature to date focuses on cross sectional analyses, while Koshal and Koshal (1998) is notable for the estimation of a 2SLS model of the supply and demand factors influencing fees simultaneously. The remaining papers focus on a single equation model of the factors impacting on US undergraduate fees. Research has not uncovered any (hedonic) pricing models of MBA fees, despite the premium fees often set by institutions across the world. Consequently, this paper offers a number of contributions to the literature on the factors impacting on university fees. The paper offers an analysis of MBA tuition fees, both

in the US and across the world. Further, the panel data set is notable for the length of data used as well as the number of universities sampled. Finally, it is argued that the analysis is strengthened by the recognition that not only fees, but also demand for an MBA is endogenously determined, such that simultaneous equation methods are required.

3. DATA

The main data source is successive editions of the Which MBA Guide, published annually since 1989 by The Economist. This contains information on MBA programmes, increasingly from countries across the world, although earlier editions focused on US and European programmes. Some data in the Guide are collected directly from each institution, for example data on fees, staff and student numbers, accreditations and the number of overseas placements available. However, since 1993, alumni have also been surveyed and aggregated responses are reported, allowing us to use variables that reflect alumni views of the programmes undertaken.

The Which MBA guide has produced an overall ranking of the top MBA programmes since the 2002 edition of the Guide. The ranking is constructed from a weighted average of the current and previous two years' data (the weights are 50 percent for the current year, 30 percent for the year before, and 20 percent for two years before) to reduce the volatility in the rankings. The Financial Times (FT) has also produced a ranking of MBA programmes since 1999. Similar to the Which MBA rankings, the FT rankings are based on a weighted average of three years' data (in this case, the weights are 50 percent for the current year, and 25 percent for each of the previous two years). These FT rankings have been added to the dataset, allowing an estimate of the impact of both sets of rankings on applications and fees to be made. Even if some students do

not read either the Which MBA guide or the FT rankings prior to selecting programmes to apply to, most students will be aware of the approximate position of a programme in the rankings as universities will highlight a good placing in any marketing materials.[2]

In the Which MBA Guide, monetary values are given in the domestic currency until 2006, after which US dollar values are reported. All monetary values from 2006 and before are converted into US dollars using the year-average exchange rates obtained from the International Financial Statistics of the International Monetary Fund (IMF). The resulting US dollar values are converted into real terms using the year-average Consumer Price Index (CPI) of each country, obtained from the World Economic Outlook database of the IMF.

The final sample is an unbalanced panel, covering 17 years from 1994 to 2010 and 1249 observations from 132 universities, with 582 observations from 53 universities in a sample restricted to US universities. Table 1 lists the number of observations and universities by country in our sample. As the data are from the Which MBA Guide, the observations relate to MBA programmes identified by that publication as the best quality MBA programmes, including, since 2002, the programmes that the guide ranks as amongst the top 100 in the world. Figure 1 shows that, for these programmes, there has been an increase in the number of applications per place over time. The GMAC annual Geographic Trend Report (2011) indicates that the average

[2] Other MBA programme rankings exist, including the Business Week and US News rankings as high profile alternatives. The US News ranks were not used in this paper as the focus is exclusively US-based, while the Business Week rankings are only published in full biannually, and do not include a combined World ranking, instead providing separate US and Rest of the World rankings. Nevertheless, using the 2010 rankings of each of the four publications, the correlation between each pair of rankings was never lower than 0.73, suggesting confidence in the Which MBA Guide and FT rankings used.

number of reports sent per candidate of the GMAT test has remained fairly constant at 2.9 to 3.0 reports between 2000 and 2010, so the majority of the increase in applications shown in Figure 1 may be attributed to an increase in the number of applicants rather than an increase in the number of applications per applicant. This increase in demand is also reflected in increasing fees over time, as shown in Figure 2. This figure also shows that post-MBA starting salaries have been rising over time, and further that in recent years these salaries have exceeded average US salary levels that are shown on Figure 2 for comparison purposes. Simultaneously, there is evidence of higher quality MBA students as can also be seen in Figures 3 and 4, which document an increase in the average GMAT scores and average months of previous work experience of students on these programmes.

Table 2 provides some descriptive statistics of the variables used in the basic econometric specification. "Overall" refers to the overall mean and standard deviation of the sample; "between" refers to the difference between the means of each university; "within" refers to the variation within each university over time. Table 2 shows that there is a large amount of variation both within and between universities in all variables. In addition, compared to non-US universities, US universities charge higher real fees, have more applications per place, occupy lower ranks in both the Which MBA guide and the FT rankings (indicating higher quality), and have students with higher average GMAT scores and less work experience. However, there is no significant difference in post-MBA salaries between US and non-US universities.

4. ECONOMETRIC METHODS

We estimate a system of two simultaneous equations, one of fees, the other for applications, as a function of several explanatory variables. Since our main objective is to determine whether or not there exists a market mechanism in the MBA sector, our baseline specification is the following:

$$Fees_{it} = \alpha_1 + \beta_{11} \ln(Apps\ Ratio)_{it-1} + \beta_{12}(Av\ GMAT)_{it-1} + \gamma_{1i} + \delta_{1t} + \varepsilon_{1it} \quad (1)$$

$$ln(Apps\ Ratio)_{it} = \alpha_2 + \beta_{21}(Fees)_{it} + \beta_{22}(Av\ GMAT)_{it-1} + \gamma_{2i} + \delta_{2t} + \varepsilon_{2it} \quad (2)$$

where γ_{1i} and γ_{2i} are university-specific effects, and δ_{1t} and δ_{2t} are time-specific effects. Time-invariant university-specific effects may include university reputation, while time-specific effects may include the recession of 2008-09 which may be expected to impact on all universities in the sector. Equation (1) states that (real) fees[3][4] charged by university *i* in year *t* are determined by the natural log of the applications ratio (number of applications divided by number of places[5]) in the previous year, the average GMAT score in the previous year, time- and university-specific

[3] In additional sensitivity checks we also use the university's real fees relative to the fees charged by other universities in the same country (or region in the US), to capture the idea that universities may set their fees depending on what their local rivals do. The regression results using this alternative measure of fees are qualitatively similar to the results reported below for real fees.

[4] We have also experimented with using the natural log of fees in equations (1) and (2); however, the results were much weaker than when fees are included linearly as in equations (1) and (2). This suggests that including fees in levels rather than in logs is the preferred functional form for this system of equations.

[5] We use the applications ratio instead of applications, since the applications ratio captures the excess demand for places. Larger MBA programmes may be expected to have more applications, *ceteris paribus*, so using the applications ratio controls for this effect. In addition, the coefficient of variation within each university over time is much lower for intake than for total applications (0.355 compared to 0.903), so that much of the variation in applications per place within universities over time is due to changes in applications rather than changes in intake.

effects, and an error term. Similarly, equation (2) states that the natural log of the ratio of applications to places in university *i* in year *t* are determined by real fees in the current year, average GMAT in the previous year, time- and university-specific effects, and an error term.

If MBA fee-setting responds to the market forces of demand in the form of the number of applications, and if demand responds to the market forces of price in the form of fees, then equations (1) and (2) will be simultaneously determined, and we would expect $\beta_{11} > 0$ and $\beta_{21} < 0$; that is, higher applications in the previous year should encourage universities to charge higher fees in the current year, while higher fees in the current year should restrict applications in the current year. The Average GMAT score proxies for the quality of the student body; a higher average GMAT score would imply higher quality students and hence the possibility of charging higher fees for what may be expected to be a better quality product. Reflecting this, β_{12} should be positive. On the applications side, higher average GMAT scores may encourage applications by signalling the quality of the programme, or may discourage applications by posing too high a barrier for potential applicants. Many institutions have on their websites a section detailing the average GMAT scores obtained by previous cohorts of students, so this information is readily available to prospective applicants. The inclusion of both time and university-specific effects means that the coefficients are identified from changes in the variables for each university over time.

We take the first differences of equations (1) and (2) to eliminate the university-specific effects. This gives:

$$\Delta Fees_{it} = \beta_{11}\Delta ln(Apps\ Ratio)_{it-1} + \beta_{12}\Delta(Av\ GMAT)_{it-1} + \Delta\delta_{1t} + \Delta\varepsilon_{1it}$$

$$\Delta ln(Apps\ Ratio)_{it} = \beta_{21}\Delta(Fees)_{it} + \beta_{22}\Delta(Av\ GMAT)_{it-1} + \Delta\delta_{2t} + \Delta\varepsilon_{2it}$$

where Δ is the first difference operator. Since having first differenced time dummies is inconvenient (see Wooldridge, 2003 for a discussion), we estimate the first-differenced equations with time dummies in levels, as follows:

$$\Delta Fees_{it} = \beta_{01} + \beta_{11}\Delta ln(Apps\ Ratio)_{it-1} + \beta_{12}\Delta(Av\ GMAT)_{it-1} + \delta_{1t} + \Delta\varepsilon_{1it} \quad (3)$$

$$\Delta ln(Apps\ Ratio)_{it} = \beta_{02} + \beta_{21}\Delta(Fees)_{it} + \beta_{22}\Delta(Av\ GMAT)_{it-1} + \delta_{2t} + \Delta\varepsilon_{2it} \quad (4)$$

Equations (3) and (4) are estimated simultaneously using Three Stage Least Squares (3SLS) estimation[6]. Fees and application ratios are both endogenous, so instrumented values of both variables are obtained. To help identify the two equations, we include two additional instruments which are not part of equations (3) and (4): these are the twice-lagged fees and application ratios, in levels. This follows the Anderson-Hsiao (1981) method of instrumenting variables in differences with the respective lags in levels; Anderson and Hsiao (1981) show that this yields consistent estimates in a dynamic 2SLS model[7]. Later in our results tables we report the F-

[6] A key assumption is that $\Delta\varepsilon_{1it}$ and $\Delta\varepsilon_{2it}$ are uncorrelated over time, for the standard errors to be valid under first-differencing. We test the residuals from the regressions for serial correlation, and find evidence of negative serial correlation in the first-differenced residuals. Therefore, the usual OLS standard errors may not greatly understate the correct standard errors (see Wooldridge, 2003 for discussion).

[7] It is possible to substitute the one-period lag of equation (4) into equation (3) and write it as the change in fees as a function of lagged change in fees, eliminating the applications ratio from the model. Doing this yields the expected negative coefficient on the lagged change in fees; this coefficient is less than 1, which suggests that this year's change in fees may be partly in response to the previous year's change; in particular, that it represents a partial adjustment to the previous year's change.

statistic of these two additional instruments in the first stage regressions; they are always highly significant, suggesting that they are strongly correlated with the instrumented variables.

We performed the Fisher-type panel-unit-root test on the main variables in equations (3) and (4): fees, the natural log of the applications ratio, and the average GMAT score, all in first differences. The highly unbalanced nature of our panel and the presence of gaps in the data prevent us from performing other panel-unit-root tests. The null hypothesis is that all panels contain a unit root, while the alternative is that at least one panel is stationary. The test rejects the null hypothesis for each variable at every conventional significance level, which suggests that our data does not have unit roots in every panel.

In addition to the basic specification estimated in equations (3) and (4), the results of which are reported in Section 5.1 below, we also estimate models which include additional control variables to test the robustness of the results. These results are discussed in Section 5.2. We also compare our results with results estimated with OLS separately for the two equations, ignoring the simultaneity; these results are reported in Section 5.3. Finally, whilst our main sample includes universities from many countries, around 40 percent of our sample comes from the US. It may be argued that the US market for MBAs is more unified than the global market, and also that our US sample covers a larger fraction of the US market than our global sample covers of the global market (for example, there is only one Japanese university in the sample: the International University of Japan). Therefore, in Section 5.4 we limit the sample to only US universities, and report the results for this sample.

5. RESULTS

This section reports the regression results using the methods detailed above. All regressions reported are in first differences, with time-specific effects.

5.1. Fees, applications and rankings

In this section we report the results of the baseline specifications (3) and (4), relating MBA fees, the applications ratio and average GMAT scores. These results are reported in columns (1) and (2) of Table 3. The applications ratio has a significantly positive effect on fees in the coming year; that is, higher applications-to-places increases the fees charged. On the other hand, fees have a negative effect on the applications ratio; higher fees reduce the number of applications per available place. Taken together, we see this result as providing evidence that the market mechanism operates in this sector: higher prices discourage demand, whilst higher demand in the previous year encourages firms to increase current prices.[8] The average GMAT score has no significant effect on fees, but has a significantly positive effect on applications. This indicates that universities do not take into account the academic abilities of their students in deciding on fee changes, but that applicants are attracted by higher GMAT scores in the past. Any degree could be considered to be an experience good, for which applicants cannot obtain full information in advance of choosing a university. Given the premium fees typically charged for MBAs and the opportunity cost in terms of forgone salaries of studying for a full-time MBA, applicants may be expected to consider carefully their application choices; the quality of previous students appears to be used as a signal of degree quality.

[8] If the market mechanism works effectively, then prices should be observed to fall as well as rise, depending on market conditions. In the dataset, we observe 297 occurrences of nominal fee decreases, and once we convert fees into US dollars and correct for inflation, we find 552 instances of real fee reductions.

Columns (3) to (6) of Table 3 include two different measures of the ranking of MBAs. If this sector behaves like a market for an experience good, and if MBA rankings signal the (true or perceived) quality of the programme, then a change in the MBA ranking would reflect changes in the quality of the programme, as distinct from time-invariant reputation which would be eliminated by the first-differencing. We may expect that higher-quality programmes may attract more applicants for each available place, controlling for prices and entry standards. This idea is tested in columns (3) to (6) of Table 3. First, in columns (3) and (4), we use the ranking produced by the Which MBA guide published annually by the Economist. MBA rankings are available from this source starting in 2002. We find that the Which MBA guide ranking has no significant impact on either the fee charged or the applications ratio. The results for the other variables remain qualitatively similar to those in columns (1) and (2).

Although the Which MBA guide is the main source of the data used in this paper, it remains an open question as to whether other MBA rankings are more influential in the sector. We therefore consider the rankings published by the Financial Times. In columns (5) and (6), we use the Financial Times MBA rankings, starting from the year 1999. We find that the Financial Times ranking has no significant impact on the fee charged, but has a significantly positive effect on the application ratio. This indicates that higher rank (lower quality) increases applications, which seems puzzling. It may be that a university that moves up the league table discourages speculative applications from less-able students. It is also possible that this is the result of a sample selection problem since not all the universities in the Which MBA guide are in the

Financial Times guide. Nevertheless, the results of the other variables remain the same as before[9].

The conclusion that published rankings have little effect on MBA applications contrasts with the prevalent result in the rest of the literature. Griffith and Rask (2007), Bowman and Bastedo (2009) and Luca and Smith (2011) all identify a significant, positive impact of improvements in published ranking position on US undergraduate applications, with this effect more marked for top ranked US colleges. Consequently, the analysis below considers whether alternative factors instead affect MBA programme applications.

5.2. Robustness to additional control variables

In this section we check the robustness of our main result, that is, the relationship between fees and applications, to the inclusion of additional explanatory variables that may impact on fees and applications. Data for these additional variables are obtained from the Which MBA guide, and the results of the regressions including these additional variables are reported in Tables 4 and 5. For ease of exposition we group these additional variables into four groups: student characteristics, professional accreditations, faculty characteristics, and student perceptions. As before, all variables are in first differences[10].

[9] Using the natural log of rank instead of rank in levels yields almost identical results to those reported in Table 3.

[10] In unreported results we also include (real) application fees in first differences as an additional explanatory variable in both equations. This is motivated by the idea that application fees may reduce the number of speculative applications, and in so doing, may reduce the cost of administering a programme, hence possibly leading to lower tuition fees. However, we found little significant effect of application fees on either the application ratio or tuition fees.

The first group of additional variables, student characteristics, includes the average work experience of students in the programme, the average real salary in US dollars obtained by graduates from the programme, the average age of students, and the percentage of female and foreign students. The results of including these variables are in columns (1) and (2) of Table 4. We find that higher post-MBA salaries increase both fees and the applications ratio. This is as we may expect; higher post-MBA salaries may increase the attractiveness of the programme and hence raise demand, increasing both price and quantity demanded[11]. There is weak evidence that a higher percentage of female students reduces the applications ratio, which may suggest that women make fewer applications. The results on fees and applications remain the same as before: higher fees discourage applications, whilst higher applications encourage higher fees in future.

The second group of additional variables, professional accreditations, reflect the growing importance of quality assurance as the number of MBA programmes has increased globally. Professional accreditation may be viewed as another signal of quality; this may be expected to increase both fees and applications. We use a set of three dummy variables for whether or not a programme/business school is accredited by the three main business school accreditation bodies: AACSB (Association to Advance Collegiate Schools of Business), EQUIS (European Quality Improvement System), and AMBA (Association of MBAs). Although EQUIS is a European body, EQUIS accreditation is not restricted to European schools. As with other variables, in the reported results in columns (3) and (4) of Table 4 we use the change in the dummy variable (reflecting attainment or loss of accreditation) as the explanatory variable in the regression; using

[11] Data is also available on the percentage increase in salaries post-MBA. This has no significant effect on either fees or applications, and limited data availability means that we lose over half the sample when including this variable, so we do not report these results in the tables.

the accreditation dummy in levels does not change the results, nor does adding the dummies in levels or first differences to reflect a measure of "total accreditation". We also experimented with interacting the accreditation dummies with continent dummies to reflect the regional orientation of the accreditation bodies, and these interactions also do not have any significant impact on fees or applications. In all cases, accreditation has no significant impact on either applications or fees, and inclusion of the accreditation dummies does not change the basic relationship between applications and fees. What this suggests is that professional accreditation may not be very important to students in the MBA market, although Hussey (2011b) concludes that AACSB accreditation is associated with higher returns to an MBA qualification in the US.

The third group of additional variables is the characteristics of the faculty of an MBA programme. It may be hypothesized that superior faculty either in terms of research reputation or teaching quality may be prized by students, thus raising demand and hence applications and fees. We use three variables: the percentage of faculty with PhDs, student evaluation of the quality of the faculty, and the ratio of faculty to students. This last variable is potentially subject to severe measurement error, as although universities report the number of faculty involved in the MBA programme, the intensity of involvement may be quite different across universities, or even within the same university over time. Hence the results reported in columns (1) and (2) of Table 5 should be interpreted with caution. The only faculty variable that is marginally significant is the ratio of faculty to students, suggesting that a higher ratio of faculty to students discourages applications. However, as noted above this variable is measured with error, so the implications of this result are not clear. In any case, the basic results relating applications to fees remain

unchanged from the previous results, and the results are robust to the exclusion of the ratio of faculty to students variable.

The fourth group of additional variables reflect student perception of the programme undertaken. Current students and alumni who graduated in the last three years were surveyed by the Which MBA guide on various aspects of the programme. We use the student perceptions of the quality of facilities, the careers services, student perception of the culture and their classmates, and the overall student perception of the programme. The results are reported in columns (3) and (4) of Table 5. We find that none of the student perceptions have any significant effect on either fees or applications. Note that this result (and the previous results) of mostly insignificant covariates is probably not driven by multicollinearity, since all variables used are in first differences. Even though some of the variables are highly correlated with each other in levels, the largest correlation between the additional variables in first differences is 0.57, with the majority of correlations less than 0.2. Once again the relationship between fees and applications is obtained. We therefore conclude that neither fees nor applications are influenced by perceptions of current and previous students; this is an interesting result, since the nature of education as an experience good (Nelson 1970) would have suggested that prospective students would place at least some weight on the perceptions of previous students.

5.3. Comparison with OLS results

Our use of 3SLS techniques has been justified on the basis of the idea that both fees and applications are determined simultaneously, and that failing to take this simultaneity into account

would result in biased estimates. In this section we test whether this is indeed the case, and compare the previous results with results from OLS estimation of each equation separately. The results are reported in Table 6, where we report the results of estimating our baseline equations (3) and (4) without any additional controls. This enables a direct comparison with columns (1) and (2) of Table 3.

In column (1) of Table 6, we find that, using OLS, there is no significant effect of either the application ratio or the average GMAT on fees; this is different from the 3SLS result in which the application ratio has a robustly positive effect on fees. In column (2), average GMAT has no significant effect on the application ratio, but fees have a positive relationship with applications. Once again this result is different from that obtained by 3SLS, in which controlling for the endogeneity of fees results in a robustly negative relationship between fees and applications. These differences in results between OLS and 3SLS may be attributed to the simultaneity bias which is not taken into account with OLS estimation.

Table 6 also reports the results of a test of the endogeneity of fees in the applications equation, and applications in the fee equation. The null hypothesis for this test is that the variable in question is exogenous. The test statistic is distributed as chi-squared, and is defined as the difference in the Sargan-Hansen statistics between the equation in which the variable in question is assumed to be endogenous, and the equation in which the variable in question is assumed to be exogenous (see Baum et. al., 2007 for more details). We find that fees are endogenous to applications, while applications are not endogenous to fees. Nevertheless, the endogeneity of fees in the applications equation appears to be sufficient to bias the OLS results of both

equations. Therefore, the results of Table 6 provide evidence to support our use of 3SLS methods to correct for this endogeneity bias.

5.4. Results for US sample

The results in the previous section have been based on all available universities in the Which MBA guide. As shown in Table 2, these universities are located in many different countries. This highlights the internationalisation of the MBA market. However, at the same time, our sample only consists of a small fraction of the total global MBA market. Therefore we may not be able to capture a more complete picture of this market. In this section we adopt a different approach; we take US MBA programmes as our sample. By doing so, we may have a more unified market, in the sense that a potential applicant may see this market as a unified whole, and at the same time, universities in the US are more likely to regard other US universities as their competitors. Also, our sample consists of a relatively large number of US universities; therefore we may be more confident that we have included the majority of the most important MBA programmes in the US.

Using the US sample, we replicate the foregoing analysis. For brevity we report only the analogue of Table 3, our baseline specification plus rankings, in Table 7. We find broadly the same results as when we use the World sample[12]. That is, higher MBA fees are associated with a lower applications-to-places ratio, while higher applications in the previous year result in higher fees in the current year. In the US sample, unlike in the World sample, average GMAT score has

[12] We also obtain similar results to the World sample when we use the US sample with the additional control variables. In particular, the simultaneous relationship between fees and applications is obtained for every specification.

no significant impact on either applications or fees. Similarly, MBA rankings, whether measured by the Which MBA guide or the Financial Times, have no significant effect on either variable. As before, we interpret our results as saying that market forces of supply and demand operate in the MBA sector. However, in the US, neither universities nor applicants are influenced by rankings, or by information on the quality of current students, whereas such information has some influence in the world as a whole.

6. CONCLUSIONS

The main focus of this paper is to investigate the relationship between MBA fees and applications, using a sample of MBA programmes across the world from 1994 to 2010. To take into account the simultaneous determination of fees and applications, we estimate a two-equation model using 3SLS methods. We find that higher fees result in fewer applications per place, while higher applications per place result in higher fees in future. We interpret this result as saying that the MBA sector operates based on market forces of demand and supply; that higher demand for places leads universities to charge higher prices, while, conversely, higher prices choke off demand. These findings are robust to controlling for other explanatory variables including published programme rankings, student and faculty characteristics, student perceptions, and professional accreditations, and for a subsample of US universities. We also show that ignoring the simultaneity and estimating the two equations using OLS leads to different results, which we attribute to simultaneity bias.

Our results are obtained by estimating the equations in first differences. This means that any time-invariant university effects cannot be estimated. However, Ridgers (2009) reports that, in a

survey of MBA students, the reputation of the school was the most important factor in choosing an MBA programme. If reputation (as distinct from rankings) does not change rapidly, then it may be regarded as a university fixed effect, and hence our methodology means that we would not be able to estimate the effect of reputation on fees or applications, even if we were able to obtain such a measure. Future research therefore could adopt alternative estimation methods and new data that enable us to identify the relative importance of these university effects on fees and applications.

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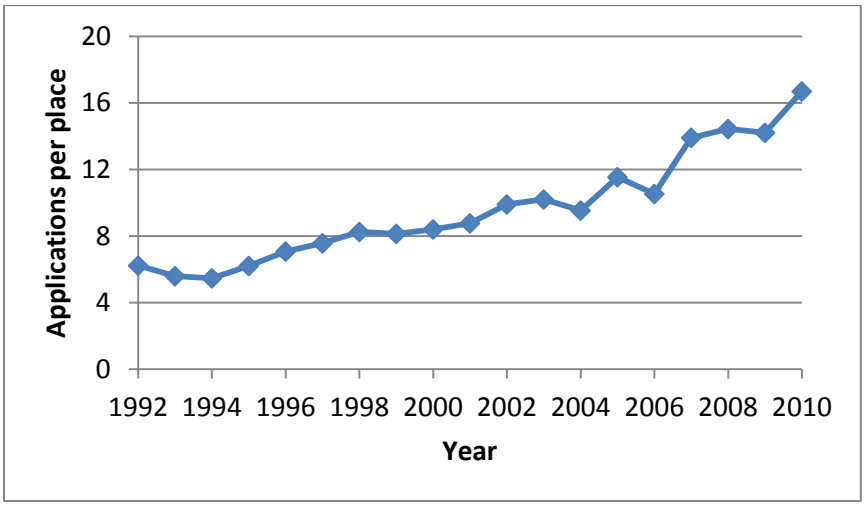
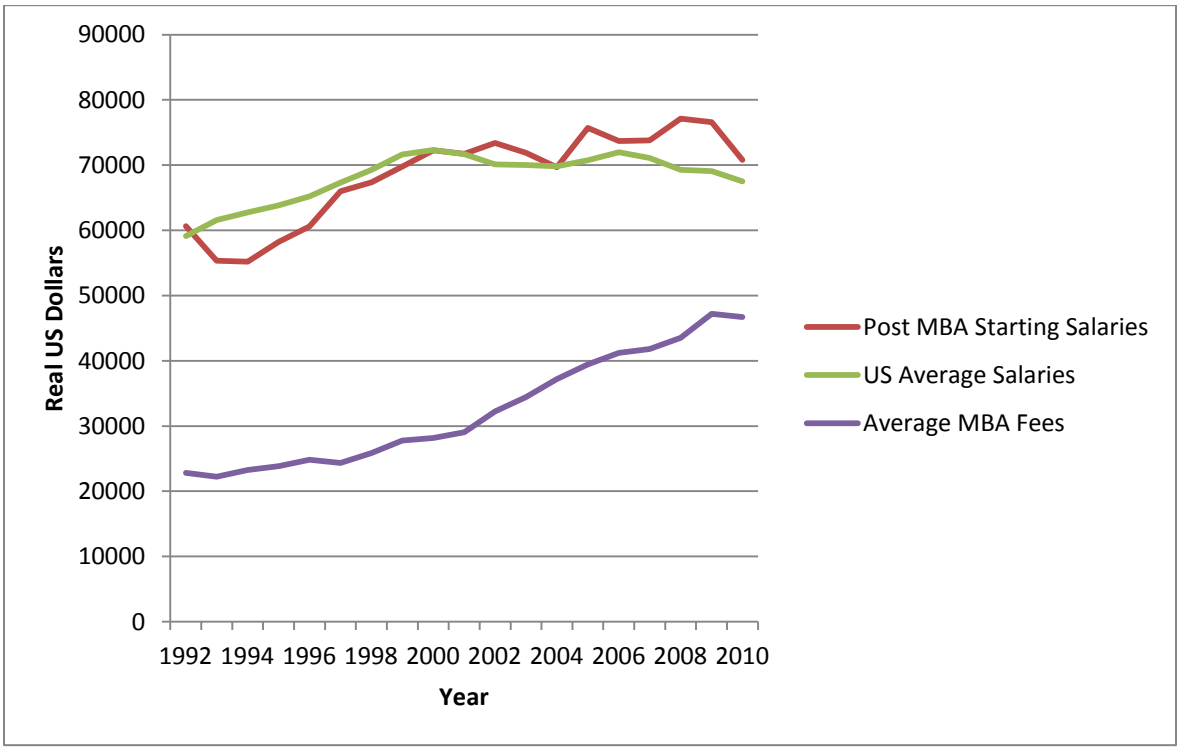
Figure 1: Average MBA applications to places ratio over time



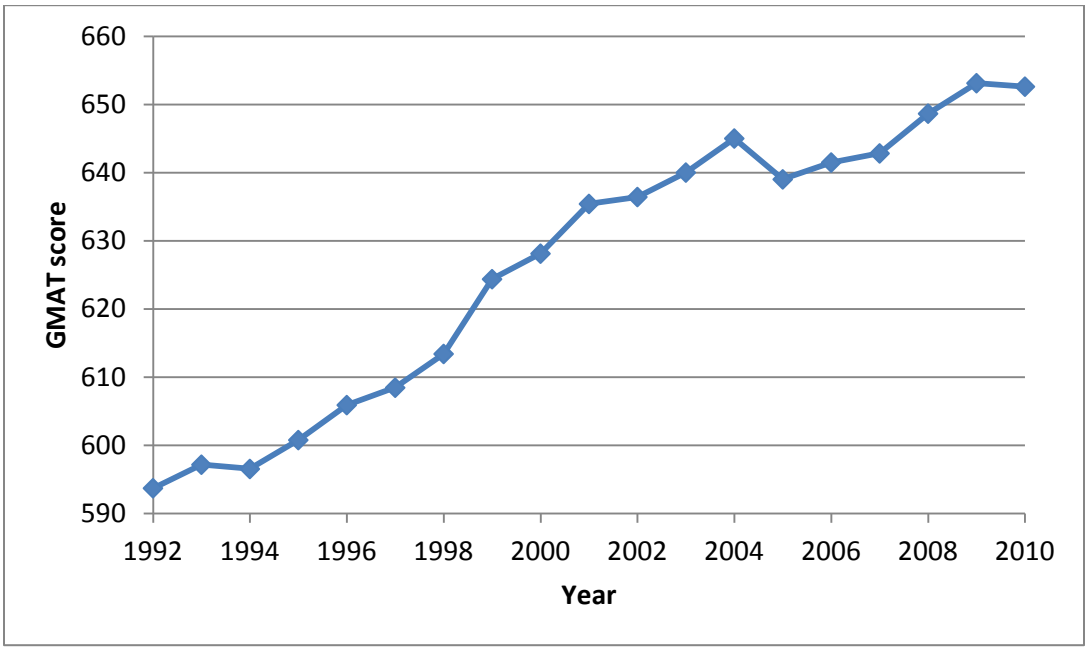
Source: Which MBA Guides

Figure 2: Average real fees and post MBA starting salaries



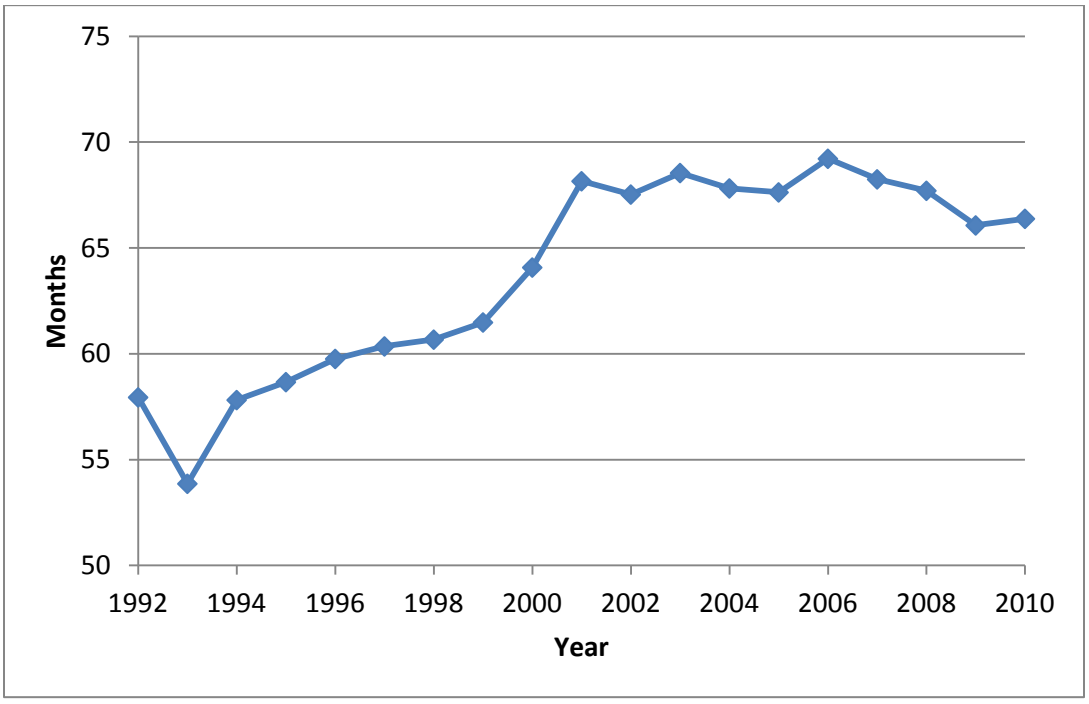
Source: Which MBA Guides

Figure 3: Average GMAT scores over time



Source: Which MBA Guides

Figure 4: Average months of previous work experience



Source: Which MBA Guides

Table 1: Number of observations and universities by country.

Country	Observations	Universities
Australia	38	5
Belgium	17	4
Canada	50	9
China	8	1
Finland	11	1
France	70	8
Germany	1	1
Hong Kong	31	3
Ireland	24	2
Italy	11	1
Japan	6	1
Mexico	2	1
Monaco	13	1
Netherlands	37	3
New Zealand	10	1
Norway	15	2
Singapore	13	2
Spain	54	4
Switzerland	13	1
UK	243	28
US	582	53
Total	1,249	132

Table 2: Descriptive statistics

Variable		World sample Mean	Std Dev	Observations	US sample Mean	Std Dev	Observations	World sample excluding US Mean	Std Dev	Observations
Real fees (000 US$)	overall	35.47	17.62	N = 1249	46.76*	15.59	N = 582	25.61	12.69	N = 667
	between		15.52	n = 132		11.93	n = 53		9.15	n = 79
	within		9.29	T-bar = 9.46		10.25	T-bar = 10.98		8.37	T-bar = 8.44
Application ratio	overall	6.237	4.84	N = 1249	7.05*	3.29	N = 582	5.53	5.78	N = 667
	between		3.66	n = 132		2.70	n = 53		4.16	n = 79
	within		3.51	T-bar = 9.46		1.76	T-bar = 10.98		4.52	T-bar = 8.44
Which MBA rank	overall	48.00	28.31	N = 637	41.75*	26.29	N = 321	54.35	28.92	N = 316
	between		27.51	n = 110		25.79	n = 49		26.19	n = 61
	within		11.85	T-bar = 5.79		9.70	T-bar = 6.55		13.71	T-bar = 5.18
Financial Times rank	overall	43.28	26.91	N = 704	38.94*	25.17	N = 391	48.72	28.04	N = 313
	between		26.98	n = 104		24.61	n = 50		26.92	n = 54
	within		11.56	T-bar = 6.77		9.89	T-bar = 7.82		13.37	T-bar = 5.79
Average GMAT	overall	634.9	41.77	N = 1201	654.5*	36.88	N = 572	617.1	37.85	N = 629
	between		37.96	n = 129		32.46	n = 53		33.38	n = 76
	within		21.79	T-bar = 9.31		20.92	T-bar = 10.79		22.57	T-bar = 8.28
Real post-MBA salary (000 US$)	overall	72.07	19.11	N = 1123	71.73	12.51	N = 567	72.41	24.06	N = 556
	between		16.96	n = 124		10.31	n = 53		20.62	n = 71
	within		11.02	T-bar = 9.06		7.31	T-bar = 10.69		13.82	T-bar = 7.83
Previous work experience (months)	overall	63.64	20.43	N = 1234	53.49*	9.78	N = 577	72.55	23.03	N = 657
	between		19.13	n = 131		7.15	n = 53		21.34	n = 78
	within		10.35	T-bar = 9.42		7.55	T-bar = 10.89		12.30	T-bar = 8.42

Note: * indicates that the difference in means between the US and non-US samples is statistically significant at 1%.

Table 3: Regression results: Fees, applications and rankings

	(1) D Real fees	(2) D lnAppRatio	(3) D Real fees	(4) D lnAppRatio	(5) D Real fees	(6) D lnAppRatio
LD log application ratio	1.577		2.044		1.974	
	(0.173)***		(0.448)***		(0.459)***	
LD average GMAT	0.010	0.004	-0.005	0.005	0.010	0.004
	(0.008)	(0.001)***	(0.018)	(0.002)**	(0.020)	(0.002)*
D real fees		-0.259		-0.102		-0.140
		(0.020)***		(0.029)***		(0.018)***
LD rank			-0.027	-0.001		
			(0.020)	(0.002)		
LD FT rank					0.022	0.005
					(0.019)	(0.002)**
Eq F-stat	9.11***	10.33***	6.06***	4.16***	4.63***	6.60***
F-stat excluded instruments	8.32***	40.01***	4.08**	21.63***	7.15***	27.04***
Time period	1994-2010	1994-2010	2004-2010	2004-2010	2001-2010	2001-2010
Universities	132	132	102	102	91	91
N	1,249	1,249	488	488	551	551

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables are in first differences, and all regressions include time-specific effects. Each pair of equations (Real fees and log application ratio) is estimated simultaneously using 3SLS. D denotes the first difference operator, and L denotes the first lag operator. F-stat excluded instruments is the F-statistic of the test of the joint significance of the two additional instruments used in identifying the system; see the text for further details.

Table 4: Regression results: Additional controls 1: Student characteristics and accreditation.

	(1) D Real fees	(2) D lnAppRatio	(3) D Real fees	(4) D lnAppRatio
LD log application to intake ratio	1.607		2.160	
	(0.192)***		(0.377)***	
LD average GMAT	0.007	0.003	0.013	0.006
	(0.010)	(0.002)**	(0.018)	(0.003)**
LD average work experience	-0.006	0.001		
	(0.014)	(0.002)		
LD real salary	0.082	0.024		
	(0.015)***	(0.003)***		
LD average age	0.152	0.035		
	(0.151)	(0.025)		
LD percentage of women students	-0.011	-0.006		
	(0.023)	(0.004)*		
LD percentage of foreign students	0.001	-0.000		
	(0.012)	(0.002)		
LD real fees		-0.258		-0.165
		(0.021)***		(0.037)***
LD AACSB membership			-2.117	-0.246
			(1.641)	(0.244)
LD AMBA membership			1.654	0.248
			(2.726)	(0.388)
LD EQUIS membership			1.342	0.309
			(1.801)	(0.256)
Eq F-stat	7.10***	7.30***	5.46***	2.96***
F-stat excluded instruments	6.97***	31.68***	2.85*	15.38***
Time period	1994-2010	1994-2010	2006-2010	2006-2010
Universities	122	122	105	105
N	1,027	1,027	405	405

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables are in first differences, and all regressions include time-specific effects. Each pair of equations (Real fees and log application ratio) is estimated simultaneously using 3SLS. D denotes the first difference operator, and L denotes the first lag operator. F-stat excluded instruments is the F-statistic of the test of the joint significance of the two additional instruments used in identifying the system; see the text for further details.

Table 5: Regression results: Additional controls 2: Faculty characteristics and student perceptions

	(1) D Real fees	(2) D lnAppRatio	(3) D Real fees	(4) D lnAppRatio
LD log application to intake ratio	2.126		1.701	
	(0.376)***		(0.193)***	
LD average GMAT	0.015	0.006	0.009	0.004
	(0.018)	(0.003)**	(0.010)	(0.002)**
LD real fees		-0.169		-0.241
		(0.038)***		(0.018)***
LD percentage of PhDs in faculty	0.015	0.003		
	(0.032)	(0.005)		
LD student evaluation of faculty	-2.259	-0.242		
	(1.427)	(0.224)		
LD faculty per student	-0.629	-0.128		
	(0.500)	(0.075)*		
LD student perception of facilities			-0.486	-0.206
			(0.893)	(0.144)
LD student perception of careers services			0.042	0.046
			(0.471)	(0.076)
LD student perception of the programme			-0.337	-0.060
			(0.959)	(0.155)
LD student perception of culture and classmates			0.062	0.057
			(0.875)	(0.141)
Eq F-stat	5.42***	2.99***	6.21***	8.71***
F-stat excluded instruments	2.58*	15.24***	9.01***	32.81***
Time period	2006-2010	2006-2010	1995-2010	1995-2010
Universities	102	102	122	122
N	399	399	1,100	1,100

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables are in first differences, and all regressions include time-specific effects. Each pair of equations (Real fees and log application ratio) is estimated simultaneously using 3SLS. D denotes the first difference operator, and L denotes the first lag operator. F-stat excluded instruments is the F-statistic of the test of the joint significance of the two additional instruments used in identifying the system; see the text for further details.

Table 6: Separate OLS regressions of both dependent variables.

	(1) D Real fees	(2) D lnAppRatio
LD log application to intake ratio	0.321	
	(0.422)	
LD average GMAT	0.009	0.001
	(0.006)	(0.001)
LD real fees		0.006
		(0.002)**
R^2	0.06	0.05
Time period	1994-2010	1994-2010
Universities	132	132
N	1,249	1,249
Test endogeneity	4.67	0.30
P-value	0.031	0.583

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables are in first differences, and all regressions include time-specific effects. Each equation is estimated separately using OLS, with standard errors clustered by university. D denotes the first difference operator, and L denotes the first lag operator. The test for endogeneity is a test of the null hypothesis that the application ratio in the fee equation and real fees in the application ratio equation are exogenous. P-value is the p-value of this test. See Baum et al (2007) for details of this test.

Table 7: Fees, applications and rankings: US sample.

	(1) D Real fees	(2) D lnAppRatio	(3) D Real fees	(4) D lnAppRatio	(5) D Real fees	(6) D lnAppRatio
LD log application ratio	3.023		3.035		3.746	
	(0.375)***		(0.531)***		(0.701)***	
LD average GMAT	-0.005	-0.000	-0.024	-0.002	0.001	0.002
	(0.019)	(0.002)	(0.039)	(0.004)	(0.029)	(0.002)
LD real fees		-0.161		-0.158		-0.093
		(0.013)***		(0.015)***		(0.014)***
LD rank			-0.025	0.001		
			(0.037)	(0.004)		
LD FT rank					0.005	0.002
					(0.026)	(0.002)
LD relative fees						
Eq F-stat	5.61***	8.76***	6.19***	13.85***	4.55***	5.75***
F-stat excluded instruments	11.00***	26.11***	4.22**	15.12***	7.56***	13.84***
Time period	1994-2010	1994-2010	2004-2010	2004-2010	2001-2010	2001-2010
Universities	53	53	50	50	48	48
N	582	582	251	251	318	318

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All variables are in first differences, and all regressions include time-specific effects. Each pair of equations (Real fees and log application ratio) is estimated simultaneously using 3SLS. D denotes the first difference operator, and L denotes the first lag operator. F-stat excluded instruments is the F-statistic of the test of the joint significance of the two additional instruments used in identifying the system; see the text for further details.